UNIVERSITÀ DEGLI STUDI
eCAMPUS
TELEMATICA · DM30·01·2006

GIORNATA DI FORMAZIONE SULLA DIDATTICA INTERATTIVA

Novedrate, 24 novembre 2015

MATERIALI DI APPROFONDIMENTO

a cura di Manuela Cantoia

Sommario

Note introduttive

In questi ultimi mesi siamo stati più volte sollecitati rispetto all'avvio di una didattica interattiva all'interno dell'offerta formativa della nostra università e, in questa fase di familiarizzazione con nuovi strumenti e nuovi modi di progettare i nostri corsi, è parso utile completare gli spunti offerti dalla giornata di formazione con alcuni materiali di approfondimento.
Nel predisporre questa breve dispensa si sono seguiti due criteri fondamentali: stimolare la curiosità e introdurre gradualmente al dibattito in corso all'interno della comunità scientifica.
Dopo una breve introduzione generale che permetta di condividere alcuni riferimenti base, si è pensato utile proporre una serie di brevi abstract, in modo da offrire uno sguardo ampio che comprendesse riflessioni teoriche, documentazione di esperienze condotte presso università e enti di formazione superiore internazionali, spunti sul tema della valutazione, voci fuori dal coro.
Gli articoli sono organizzati in ordine cronologico, a partire dai più recenti. Laddove documentati, si è provveduto ad indicare i riferimenti DOI degli articoli citati.
Qualora qualcuno fosse interessato ad approfondire un tema in particolare e avesse difficoltà nel reperire il materiale, può mettersi in contatto con la prof.ssa Manuela Cantoia (manuela.cantoia@uniecampus.it).

Appunti sull'apprendimento multimediale e l'elearning

Articolo 3 del D.M. 17/4/2003 sul funzionamento delle Università Telematiche
1. I corsi di studio a distanza sono caratterizzati da:

- l'utilizzo della connessione in rete per la fruizione dei materiali didattici e lo **sviluppo di attività formative basate sull'interattività con i docenti/tutor e con gli altri studenti**;
- l'impiego del **personal computer**, eventualmente integrato da altre interfacce e dispositivi come **strumento principale per la partecipazione al percorso di apprendimento**;
- un alto grado di **indipendenza** del percorso didattico **da vincoli di presenza fisica o di orario** specifico;
- l'utilizzo di **contenuti didattici standard, interoperabili e modularmente organizzati, personalizzabili** rispetto alle caratteristiche degli utenti finali e ai percorsi di erogazione;
- il **monitoraggio continuo** del livello di apprendimento, sia **attraverso** il **tracciamento** del percorso che attraverso **frequenti momenti di valutazione e autovalutazione**.

2. L'organizzazione didattica dei corsi di studio a distanza valorizza al massimo, pur nel rispetto delle specificità dei contenuti e degli obiettivi didattici, le **potenzialità dell'Information & Communication Technology** e in particolare:

- la **multimedialità**, valorizzando un'effettiva integrazione tra diversi media per favorire una migliore comprensione dei contenuti;
- l'**interattività con i materiali**, allo scopo di favorire percorsi di studio personalizzati e di ottimizzare l'apprendimento;
- l'**interattività umana**, con la valorizzazione di tutte le tecnologie di comunicazione in rete, al fine di favorire la creazione di contesti collettivi di apprendimento;
- l'**adattività**, ovvero la possibilità di personalizzare la sequenzializzazione dei percorsi didattici sulla base delle performance e delle interazioni dell'utente con i contenuti online;
- l'interoperabilità dei sottosistemi, per il riutilizzo e l'integrazione delle risorse, utilizzati e/o generati durante l'utilizzo dei sistemi tecnologici.

LA FORMAZIONE A DISTANZA (**FaD**; Di Simone, 2002)

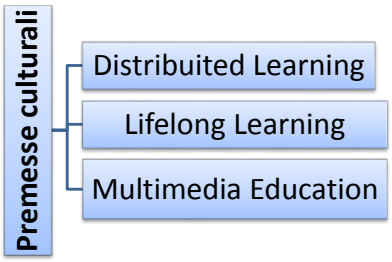
- nel processo didattico c'è separazione fisica fra docente e discente;
- l'attività formativa non è contemporanea all'erogazione della medesima;
- l'attività didattica è strutturata;
- l'erogazione del materiale didattico avviene con modalità e su supporti diversi;
- insegnante e studente sono collegati da una struttura tecnologica;
- esiste una comunicazione a due vie;
- c'è chiarezza formale su criteri e regole di studio.

LA FORMAZIONE ONLINE (De Simone, 2002; Trentin, 1998)

Percorsi orientati principalmente agli adulti, che presuppongono motivazione personale e percorsi formativi/professionali eterogenei. Comportano la possibilità di apprendere in un rapporto paritetico discenti-discenti e discenti-docenti, anche nella distanza spazio-temporale.

La didattica online si fonda sull'alternanza di:

- momenti di studio individuali;
- relazione a distanza tra gruppi o classi virtuali (*comunità di apprendimento*) che intercettano il rischio di isolamento e valorizzano l'apporto delle expertise di ciascuno.



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In principio era la FAD…

Formazione a distanza	Processo	Learning tools
I generazione	accentrato	materiali cartacei per corrispondenza
II generazione	decentrato	teledidattica (registrazioni televisive, videoconferenze), audiocassette e software didattico su Cd-Rom
III generazione	distribuito	interazione e collaborazione in rete, costituzione di comunità on line

Vantaggi dell'eLearning

- Annullamento distanze spaziali
- Autonomia di elaborazione
- Velocizzazione delle interazioni
- Memoria del percorso didattico
- Costante ampliamento, arricchimento e aggiornamento delle risorse
- Flessibilità delle forme di cooperazione-collaborazione (coppie, piccoli gruppi, gruppi ampi, FaQ, web forum)
- Utilizzazione dell'esperienza pregressa e delle competenze dei partecipanti

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Potenziali criticità

- Abilità tecniche
- Abilità nell'accesso e nella comprensione dei contenuti
- Abilità nella gestione dei tempi
- Abilità di interazione

La scelta dell'ambiente e dello strumento è funzionale all'obiettivo di apprendimento

Obiettivo di apprendimento	Modello	Tecnologie
acquisizione di nozioni/trasferimento di conoscenze	**instructor centered approach**	strumenti di videocomunicazione uno a molti
acquisizione di abilità	**learner centered approach**	ipertesti, software autore, ambienti interattivi
modificazione di modelli mentali e atteggiamenti del discente	**learning team centered approach**	ambienti collaborativi, lavagne condivise, forum online, ambienti di simulazione

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MULTIMEDIALITÀ (Mayer, 2001)

- presentazione di materiale tramite due o più dispositivi fisici di trasmissione (voce umana, lo schermo del computer, la lavagna, il proiettore);
- presentazione di materiale utilizzando due o più modalità di presentazione, verbale (parole) e figurale (immagini);
- presentazione di materiale, la cui ricezione coinvolge più sistemi sensoriali, modalità sensoriale visiva (occhi) e uditiva (orecchie).

La tecnologia multimediale aiuta gli studenti a (Jereb e Smitek, 2006; King-Dow, 2008):

- acquisire una migliore comprensione dei concetti;
- promuovere un atteggiamento positivo verso l'apprendimento.

Inoltre

- l'integrazione di testi e ambienti multimediali aiuta a sviluppare e a legare i concetti più significativi;
- gli studenti con maggiori conoscenze possono approfondire, gli studenti alle prime armi sono facilitati nell'apprendimento.

I tool multimediali sono *artefatti cognitivi* progettati per espandere e potenziare le capacità mnemoniche e cognitive degli studenti (Norman, 1993).

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Gli *artefatti cognitivi* mettono a disposizione degli studenti (Norman, 1993):

- **spazio di lavoro condiviso**: tutti possono riflettere sulle stesse informazioni e partecipare, sinergicamente, alla co-costruzione dell'apprendimento (Cornoldi, 2004);

- **memoria permanente**: il tool multimediale è una "memoria esterna" che si recupera accedendo alla piattaforma del corso. Se rispetta la "capienza" della memoria di lavoro, ne evita il sovraccarico e la conseguente perdita di informazioni (Sweller, 1998; Van Merrienboer e Sweller, 2005);

- **memoria più capace**: riducendo il carico cognitivo intrinseco, il tool multimediale permette di espandere i limiti delle capacità mnemoniche (Sweller, 1988; Sweller e Chandler, 1994);

- **elaborazione percettiva***:* la disposizione spaziale dei concetti (mappe, grafici, illustrazioni e schemi) sottolinea i rapporti reciproci (Marcus, Cooper and Sweller, 1996; Mayer e Moreno, 2003; Schnotz, 2005);

- **rispetto delle differenze individuali**: nel formato delle conoscenze e nell'accesso sensoriale (Antonietti e Giorgetti, 1991, 1993).

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Affinché le rappresentazioni delle informazioni siano corrette ed efficaci, occorre che esse (Norman, 1993):

- colgano gli aspetti salienti e rilevanti del mondo rappresentato;
- siano congeniali a chi se ne serve, potenziandone i processi di interpretazione;
- siano appropriate al compito.

La progettazione degli strumenti multimediali è costosa e, purtroppo, non sempre elicita gli effetti attesi nella promozione delle prestazioni: ad esempio, la presenza di alcuni elementi multimediali nel materiale didattico può addirittura distrarre e diminuire significativamente l'apprendimento (Dan, Feldman, e Serpanos, 1998; Dumont, 1996; Neumann, 1998; Bartscha e Cobern, 2003; Mayer, 2001; Park e Hopkins, 1993; Rieber, 1996; Sweller, Van Merrienboer e Paas, 1998).

Map

Knollmann-Ritschel, B., & Durning, S. J. (2015). Using concept maps in a modified team-based learning exercise. Military Medicine, 180(4), 64-70.
doi: http://dx.doi.org/10.7205/MILMED-D-14-00568
Abstract: Medical school education has traditionally been driven by single discipline teaching and assessment. Newer medical school curricula often implement an organ-based approach that fosters integration of basic science and clinical disciplines. Concept maps are widely used in education. Through diagrammatic depiction of a variety of concepts and their specific connections with other ideas, concept maps provide a unique perspective into learning and performance that can complement other assessment methods commonly used in medical schools. In this innovation, we describe using concepts maps as a vehicle for a modified a classic Team-Based Learning (TBL) exercise. Modifications to traditional TBL in our innovation included replacing an individual assessment using multiple-choice questions with concept maps as well as combining the group assessment and application exercise whereby teams created concept maps. These modifications were made to further assess understanding of content across the Fundamentals module (the introductory module of the preclerkship curriculum). While preliminary, student performance and feedback from faculty and students support the use of concept maps in TBL. Our findings suggest concept maps can provide a unique means of determining assessment of learning and generating feedback to students. Concept maps can also demonstrate knowledge acquisition, organization of prior and new knowledge, and synthesis of that knowledge across disciplines in a unique way providing an additional means of assessment in addition to traditional multiple-choice questions

von, d. H. (2015). Concept maps for assessing change in learning: A study of undergraduate business students in first-year marketing in china. Assessment & Evaluation in Higher Education, 40(2), 286-308. doi: http://dx.doi.org/10.1080/02602938.2014.910637
Abstract: This paper explains the application of concept mapping to help foster a learning-centred approach. It investigates how concept maps are used to measure the change in learning following a two-week intensive undergraduate Marketing Principles course delivered to 162 Chinese students undertaking a Bachelor of Business Administration programme in China. Using four scoring procedures (breadth of knowledge, relational quality, structural quality and holistic quality), student learning is assessed in terms of prior and new knowledge, as well as improvement in knowledge structure. Concept map scores are correlated with conventional measures of overall student performance. The results provide strong evidence for improvement in students' ability to externalise new learned concepts resulting from intensive instruction. Incorporating concept maps as a contemporary method of learning in the curriculum potentially enriches student learning, provides a

measure of the impact of teaching on students' learning and adds value to students' higher education experience

DeSchryver, M. (2014). Higher order thinking in an online world: Toward a theory of web-mediated knowledge synthesis. Teachers College Record, 116(12), 1-25.

Abstract: Background/Context: The rapid pace of technological change, undergirded by near ubiquitous access to the web, is producing a new learning ecology—a new ecology of information, of knowledge, of reading, of teaching, and of thinking. This instant availability of digital resources frees both time and cognitive energy that may be used to facilitate higher order thinking. This article provides a framework through which to better understand, evaluate, and scaffold the generative synthesis of knowledge in a web-mediated world. Purpose/Objective: The purpose of this article is to describe a theory that can stimulate additional scholarly work examining higher order, or generative, thinking in web-mediated environments. Research Design: The author outlines theory development based on two explicit steps. First, he reviews scholarly literature from educational psychology, reading comprehension, hypertext and web-based reading, cognitive flexibility, and creativity. Based on this process, he develops a proto-theory for web-based synthesis. Then, using this three-fold operationalization of synthesis, the author reports findings from a multiple-case study of advanced learners on the web, resulting in further elaboration of the concept of web-based knowledge synthesis. Conclusions/Recommendations: The author proposes a theory of web-mediated knowledge synthesis comprising seven interacting elements: (a) divergent keyword search phrases; (b) synthesis for meaning; (c) in-the-moment insights; (d) repurposing; (e) reinforcement; (f) note-taking; and (g) creative synthesis. Through these elements, this theory provides a road map for further exploration of how web users can construct knowledge that adds value to the information they encounter every day.

Blunt, J. R., & Karpicke, J. D. (2014). Learning with retrieval-based concept mapping. Journal of Educational Psychology, 106(3), 849-858. doi: http://dx.doi.org/10.1037/a0035934

Abstract: Students typically create concept maps while they view the material they are trying to learn. In these circumstances, concept mapping serves as an elaborative study activity—students are not required to retrieve the material they are learning. In 2 experiments, we examined the effectiveness of concept mapping when it is used as a retrieval practice activity. In Experiment 1, students read educational texts and practiced retrieval either by writing down as many ideas as they could recall in paragraph format or by creating a concept map (retrieval-based concept mapping). In Experiment 2, we factorially crossed the format of the activity (paragraph vs. concept map) and the presence or absence of the text (i.e., whether the activity involved repeated studying or retrieval practice). On a final test 1 week later that assessed verbatim knowledge and inferencing, both paragraph and concept map retrieval practice formats produced better performance than additional studying, but the 2 retrieval formats themselves did not differ. The results demonstrate the

effectiveness of concept mapping when it is used as a retrieval practice activity and show that retrieval itself, rather than merely the act of writing, drives the benefits of retrieval-based learning activities.

Ku, D. T., Shih, J., & Hung, S. (2014). The integration of concept mapping in a dynamic assessment model for teaching and learning accounting. Journal of Educational Technology & Society, 17(1), 141-153.

Abstract: The purpose of this study is to integrate the idea of concept map into dynamic assessment model for accounting education in vocational high school. By using the expert concept map and the objectives as the main reference to generate assessment questions for diagnosis purposes, students should be informed the shortcoming of learning and receive proper guidance to improve learning. A quasi-experimental single group pre-posttest design was conducted for this study. Subjects were given a pretest before treatment and posttest after treatment. In order to truly compare the performance between the treatments, the final grades of previous semester course were used to distinguish three different (high, medium, and low scores) student groups. The results show that after the intervention of computerized dynamic assessment system, posttest scores were significantly higher than pretest scores in all three groups. In addition, regardless of learning styles, when students were willing to commit time to follow the guidance, they could result in a good learning progress. Moreover, students with high degrees of completion performed significantly better than low degrees of completion students in posttest-pretest progress. Recommendations for using dynamic assessment system in accounting learning are also discussed.

Kim, M. (2013). Concept map engineering: Methods and tools based on the semantic relation approach. Educational Technology Research and Development, 61(6), 951-978. doi: http://dx.doi.org/10.1007/s11423-013-9316-3

Abstract: The purpose of this study is to develop a better understanding of technologies that use natural language as the basis for concept map construction. In particular, this study focuses on the semantic relation (SR) approach to drawing rich and authentic concept maps that reflect students' internal representations of a problem situation. The following discussions are included: (a) elaborate classifications of concept map approaches that use natural language responses (e.g., student essay); (b) the SR process of eliciting concept maps, established using studies on domain ontology; and (c) a more effective way to identify key concepts and relations from a concept map generated by the SR approach. By comparing the SR approach to other promising concept map technologies that constrain the analytical process in various ways, this study suggests that the SR approach is likely to draw richer and more authentic concept maps. In addition, this study suggests that a certain combination of graph-related metrics be used to filter key concepts from a SR concept map drawn from a written text of 350–400 words. The methods suggested in the study could be used to design an automated assessment technology for complex problem solving and to develop adaptive learning systems.

Adesope, O. O., & Nesbit, J. C. (2013). Animated and static concept maps enhance learning from spoken narration. Learning and Instruction, 27, 1-10.
doi: http://dx.doi.org/10.1016/j.learninstruc.2013.02.002
Abstract: An animated concept map represents verbal information in a node-link diagram that changes over time. The goals of the experiment were to evaluate the instructional effects of presenting an animated concept map concurrently with semantically equivalent spoken narration. The study used a 2 × 2 factorial design in which an animation factor (animated vs. static) was crossed with a representation factor (concept map vs. text). Students (N = 140) were randomly assigned to study one of four presentations on the human nervous system. The dependent measures were tests of free recall, knowledge and transfer. The concept map groups significantly outperformed the text groups on free recall and transfer. The animated concept map group did not significantly outperform the static map group. The authors hypothesize that the animated concept map provided no advantage over the static concept map because participants in both conditions were able to use the spoken narrative to sequence their reading.

Gijlers, H., & de Jong, T. (2013). Using concept maps to facilitate collaborative simulation-based inquiry learning. Journal of the Learning Sciences, 22(3), 340-374.
doi: http://dx.doi.org/10.1080/10508406.2012.748664
Abstract: Problem solving likely involves at least two broad stages, problem space representation and then problem solution (Newell and Simon, Human problem solving, 1972). The metric centrality that Freeman (Social Networks 1:215–239, 1978) implemented in social network analysis is offered here as a potential measure of both. This development research study applied centrality measures to reanalyze existing concept maps from a recent investigation (Engelmann and Hesse, Computer-Supported Collaborative Learning 5:299–319, 2010). Participants (N = 120) were randomly assigned to interdependent (i.e. hidden profiles) or non-interdependent conditions to work online in triads using CmapTools software to create a concept map in order to solve a problem scenario. The centrality values of these group-created concept maps agreed with the common relations count analysis used in that investigation and allowed for additional comparisons as well as analysis by multidimensional scaling. Specifically, the interdependent triad maps resembled the fully explicated problem space, while the non-interdependent triad maps mainly resembled the problem solution. The results demonstrate that centrality is a useful measure of knowledge structure contained in these team concept map artifacts that allows researchers to infer problem representation start and goal state transitions during problem solving.

Martínez, G., Pérez, Á. L., Suero, M. I., & Pardo, P. J. (2013). The effectiveness of concept maps in teaching physics concepts applied to engineering education: Experimental comparison of the amount of learning achieved with and without concept maps. Journal of Science Education and Technology, 22(2), 204-214.
doi: http://dx.doi.org/10.1007/s10956-012-9386-8

Abstract: A study was conducted to quantify the effectiveness of concept maps in learning physics in engineering degrees. The following research question was posed: What was the difference in learning results from the use of concept maps to study a particular topic in an engineering course? The study design was quasi-experimental and used a post-test as a measuring instrument. The sample included 114 university students from the School of Industrial Engineering who were divided into two equivalent homogeneous groups of 57 students each. The amount of learning attained by the students in each group was compared, with the independent variable being the teaching method; the experimental group (E.G.) used concept maps, while the control group (C.G.) did not. We performed a crossover study with the two groups of students, with one group acting as the E.G. for the topic of optical fibers and as the C.G. for the topic of the fundamental particles of matter and vice versa for the other group. For each of the two topics studied, the evaluation instrument was a test of 100 dichotomous items. The resulting data were subjected to a comparative statistical analysis, which revealed a significant difference in the amount of learning attained by the E.G. students as compared with the C.G. students. The results allow us to state that for the use of concept maps, the average increment in the E.G. students' learning was greater than 19 percentage points.

Surapaneni, K. M., & Tekian, A. (2013). Concept mapping enhances learning of biochemistry. Medical Education Online, 18. doi: http://dx.doi.org/10.3402/meo.v18i0.20157
Abstract: Background: Teaching basic science courses is challenging in undergraduate medical education because of the ubiquitous use of didactic lectures and reward for recall of factual information during examinations. The purpose of this study is to introduce concept maps with clinical cases (the innovative program) to improve learning of biochemistry course content. Methods: Participants were first year medical students (n = 150) from Saveetha Medical College and Hospital (India); they were randomly divided into two groups of 75, one group attending the traditional program, the other the innovative program. Student performance was measured using three written knowledge tests (each with a maximum score of 20). The students also evaluated the relevance of the learning process using a 12-item questionnaire. Results: Students in the innovative program using concept mapping outperformed those in the traditional didactic program (means of 7.13-8.28 vs. 12.33-13.93, p <0.001). The students gave high positive ratings for the innovative course (93-100% agreement). Conclusion: The new concept-mapping program resulted in higher academic performance compared to the traditional course and was perceived favorably by the students. They especially valued the use of concept mapping as learning tools to foster the relevance of biochemistry to clinical practice, and to enhance their reasoning and learning skills, as well as their deeper understanding for biochemistry.

Zwaal, W., & Otting, H. (2012). The impact of concept mapping on the process of problem-based learning. The Interdisciplinary Journal of Problem-Based Learning, 6(1), 104-128. doi: http://dx.doi.org/10.7771/1541-5015.1314

Abstract: A concept map is a graphical tool to activate and elaborate on prior knowledge, to support problem solving, promote conceptual thinking and understanding, and to organize and memorize knowledge. The aim of this study is to determine if the use of concept mapping (CM) in a problem-based learning (PBL) curriculum enhances the PBL process. The paper reports on two studies. The first study was conducted with four PBL groups, with two groups using concept mapping. In the second study, three of seven groups were assigned to use concept mapping. All PBL groups were audio- and videotaped. Results show that concept mapping did not lead to more or better matching learning goals. Neither did it affect the time spent on step 4 of the seven-step method. When evaluating the PBL session, students working with concept mapping were more satisfied with the execution of step 4, the decision-making process, and the communication within the group. Though indications exist that concept mapping might be a useful tool to enhance the process of PBL, further research is needed, controlling for the impact of the quality of the problems and the tutor interventions.

Chiu, C., & Lin, C. (2012). Sequential pattern analysis: Method and application in exploring how students develop concept maps. TOJET: The Turkish Online Journal of Educational Technology, 11(1), 145-153.

Abstract: Concept mapping is a technique that represents knowledge in graphs. It has been widely adopted in science education and cognitive psychology to aid learning and assessment. To realize the sequential manner in which students develop concept maps, most research relies upon human-dependent, qualitative approaches. This article proposes a method for sequential pattern analysis, inspired by sequential pattern mining algorithms generally applied to commercial forecast and decision supports. The method can be programmed for automatic execution and thus reasonably fast, yielding reproducible results. To validate the proposed method, 187 college students were recruited to create respective concept maps on a computerized concept mapping system. While the concept mapping data was analyzed by the sequential pattern analysis method, it was found that the mapping sequences used by students that created superior concept maps were similar and had a pattern in which propositions were formed in a temporal order from more inclusive to less inclusive. Conversely, no similarity was found in the concept mapping sequences by those who created inferior concept maps. The findings support theoretical expectations about concept mapping and are consistent with qualitative evidence based on student self-reports.

Kumar, S., Dee, F., Kumar, R., & Velan, G. (2011). Benefits of testable concept maps for learning about pathogenesis of disease. Teaching and Learning in Medicine, 23(2), 137-143. doi: http://dx.doi.org/10.1080/10401334.2011.561700

Abstract: Background: Concept maps can assist learning by integrating new information with existing cognitive structure to facilitate meaningful understanding. The benefits of testable concept maps to illustrate cause-and-effect sequences in the pathogenesis of disease have not yet been determined. Purpose: A controlled trial was employed to evaluate the learning benefits of testable

pathogenesis maps. Methods: Consecutive cohorts of junior medical students allocated to control and study groups participated in case-based pathology practical classes. Online testable pathogenesis maps were integrated into classes for the study group. An online quiz and questionnaire were used to evaluate outcomes. Results: The study group scored significantly higher on the quiz (p = .014), including significantly better performance in topics covered by pathogenesis maps (p = .049). The study group's questionnaire responses regarding pathogenesis maps were overwhelmingly positive. Conclusions: Testable pathogenesis maps significantly improved medical students' understanding of the pathogenesis of disease. Wider use of such maps should be explored.

Leauby, B. A., Szabat, K. A., & Maas, J. D. (2010). Concept mapping—An empirical study in introductory financial accounting. Accounting Education, 19(3), 279-300.
doi: http://dx.doi.org/10.1080/09639280903412334
Abstract: The AICPA's Core Competency Framework advocates a skills-based curriculum, based on the rapidly expanding body of knowledge in accounting and developing preferred skills for succeeding in the accounting profession. To address this concern, concept mapping is experimentally used in an introductory financial accounting course. Concept mapping is a learning tool involving a process of externalizing, through drawing and diagrams, the mental connections and association patterns students make on knowledge learned. Widely used in other disciplines, prior research suggests concept mapping develops more complete and organized knowledge structures, leading to more meaningful learning and higher-order thinking skills. This study tests the hypothesis that student learning in an introductory financial accounting course increases, as measured by examination scores, when traditional methods of instruction are supplemented by concept mapping activities. Extraneous variables, such as gender, SAT scores, major, and extra-credit work are tested validating no differences in the control and experimental groups potentially contributing to differences in learning outcomes. The results of the study show no statistically significant evidence supporting the stated hypothesis. A survey administered to the experimental group shows that concept mapping provides a positive student experience and is a useful learning tool. Two significant results arise from the survey response: (1) concept mapping is rated as a valuable learning tool by good concept map creators; and (2) better students indicate a preference for mapping software rather than creating maps manually.

Amadieu, F., van Gog, T., Paas, F., Tricot, A., & Mariné, C. (2009). Effects of prior knowledge and concept-map structure on disorientation, cognitive load, and learning. Learning and Instruction, 19(5), 376-386.
doi: http://dx.doi.org/10.1016/j.learninstruc.2009.02.005
Abstract: This study explored the effects of prior knowledge (high vs. low; HPK and LPK) and concept-map structure (hierarchical vs. network; HS and NS) on disorientation, cognitive load, and learning from non-linear documents on "the infection process of a retrograde virus (HIV)". Participants in the study were 24 adults. Overall subjective ratings of disorientation and cognitive load, as well as detailed analysis of eye movement and navigation data were used. The results showed

that LPK learners gained equal factual knowledge from the HS and NS concept maps, gained more conceptual knowledge from the HS concept map, and had to invest less mental effort in the posttest after learning with the HS concept map. On the other hand, HPK learners gained more factual knowledge from the HS concept map than from the NS concept map, and gained equal conceptual knowledge from both concept-map structures. Also, LPK learners experienced higher disorientation during learning with the NS concept map than the HS map, whereas no differential effect of concept-map structure was found for HPK learners. Both LPK and HPK learners invested less mental effort in processing the HS concept map. The eye tracking and navigation data provided more detailed insight into these findings.

Lim, K. Y., Lee, H. W., & Grabowski, B. (2009). Does concept-mapping strategy work for everyone? The levels of generativity and learners' self-regulated learning skills. British Journal of Educational Technology, 40(4), 606-618.
doi: http://dx.doi.org/10.1111/j.1467-8535.2008.00872.x
Abstract: The purpose of this study was to examine the effect of concept-mapping strategies with three different generativity levels (expert-generated concept map, partially learner-generated concept map, fully learner-generated concept map) on knowledge acquisition. Interaction between learners' self-regulated learning (SRL) skills and different levels of generativity was also tested. One hundred twenty-four undergraduate students, randomly assigned to three different concept-mapping groups, were differentiated by high and low levels of SRL skills. The findings suggest that the participants in the fully learner-generated map group significantly outperformed the participants in the expert-generated map group, and participants with high SRL skills significantly outperformed those with low SRL skills across all treatment levels.

Hilbert, T. S., & Renkl, A. (2009). Learning how to use a computer-based concept-mapping tool: Self-explaining examples helps. Computers in Human Behavior, 25(2), 267-274.
doi: http://dx.doi.org/10.1016/j.chb.2008.12.006
Abstract: In initial skill acquisition in well-structured domains, example-based learning typically leads to better learning outcomes than learning by doing. Cognitive Load Theory explains this result by the worked-example effect: Example-based learning prevents learners from using load-intensive strategies and focuses their attention on the principles to-be-learned. In two experiments, we investigated the use of examples for acquiring a new learning strategy, namely computer-based concept mapping. Experiment 1 compared learners who studied two examples on how to construct a concept map with learners who practiced concept mapping by constructing two concept maps on their own. We did not find significant differences in learning outcomes. Therefore, in Experiment 2, we introduced a third group of learners who studied examples with the additional support of self-explanation prompts. Self-explaining examples led to better learning outcomes than learning with examples without prompts or practicing. With respect to cognitive load, we found that examples

without prompts released learners' working memory compared to practicing, whereas self-explaining examples led to a higher cognitive load compared to examples without self-explanation.

Rueda, U., Arruarte, A., Elorriaga, J. A., & Herrán, E. (2009). Learning the attachment theory with the CM-ED concept map editor. Computers & Education, 52(2), 460-469. doi: http://dx.doi.org/10.1016/j.compedu.2008.09.015
Abstract: This paper presents a study carried out at the University of the Basque Country UPV/EHU with the aim of evaluating the CM-ED (concept map editor) with social education students. Concept mapping is a widely accepted technique that promotes meaningful learning. Graphically representing concepts of the learning domain and relationships between them helps students integrate new knowledge into their current cognitive structure. Due to the flexibility of computer-aided drawing graphs, several concept mapping tools have been developed and their use has been studied over the last few years. CM-ED is a multilingual and multimedia software program designed for drawing concept maps. Until recently, CM-ED had been mainly used and evaluated in computer science university degree. This paper represents a qualitative step in the evaluation of CM-ED: from technical students to students of more theoretical fields. The main characteristics of the CM-ED editor and the carried out study are presented in this paper.

Chiou, C. (2009). Effects of concept mapping strategy on learning performance in business and economics statistics. Teaching in Higher Education, 14(1), 55-69. doi: http://dx.doi.org/10.1080/13562510802602582
Abstract: A concept map (CM) is a hierarchically arranged, graphic representation of the relationships among concepts. Concept mapping (CMING) is the process of constructing a CM. This paper examines whether a CMING strategy can be useful in helping students to improve their learning performance in a business and economics statistics course. A single factor, between subjects experimental design with three participant groups (collaborative concept mapping (CCMING) versus individual concept mapping (ICMING) versus traditional textbook exercises (TTE)) was employed. The experimental results suggest that adopting a CMING strategy can significantly improve student learning achievement in statistics, compared to using TTE, and adopting a CCMING improves student achievement even more than using ICMING. Furthermore, most of the students were satisfied with using CMING to learn statistics.

Berry, J. W., & Chew, S. L. (2008). Improving learning through interventions of student-generated questions and concept maps. Teaching of Psychology, 35(4), 305-312. doi: http://dx.doi.org/10.1080/00986280802373841
Abstract: Using the principles of the scholarship of teaching and learning, we evaluated 2 learning strategies to determine if they could improve student exam performance in general psychology. After the second of 3 exams, we gave students the option of participating in a specific learning activity and assessed its impact using the third exam. In Study 1, participating students generated a minimum of

3 questions per week over course material. Lower performing students who participated improved their exam performance such that they were indistinguishable from stronger students who did not participate. In Study 2, students had the option of generating concept maps over course material. Generating concept maps significantly improved performance.

Chen, N., Kinshuk, J., Wei, C., & Chen, H. (2008). Mining e-learning domain concept map from academic articles. Computers & Education, 50(3), 1009-1021. doi: http://dx.doi.org/10.1016/j.compedu.2006.10.001

Abstract: Recent researches have demonstrated the importance of concept map and its versatile applications especially in e-Learning. For example, while designing adaptive learning materials, designers need to refer to the concept map of a subject domain. Moreover, concept maps can show the whole picture and core knowledge about a subject domain. Research from literature also suggests that graphical representation of domain knowledge can reduce the problems of information overload and learning disorientation for learners. However, construction of concept maps typically relied upon domain experts in the past; it is a time consuming and high cost task. Concept maps creation for emerging new domains such as e-Learning is even more challenging due to its ongoing development nature. The aim of this paper is to construct e-Learning domain concept maps from academic articles. We adopt some relevant journal articles and conference papers in e-Learning domain as data sources, and apply text-mining techniques to automatically construct concept maps for e-Learning domain. The constructed concept maps can provide a useful reference for researchers, who are new to the e-Leaning field, to study related issues, for teachers to design adaptive learning materials, and for learners to understand the whole picture of e-Learning domain knowledge.

Nazzal, S. H. (2008). Effects of the concept map as an advance organizer on university students' immediate and delayed achievement in education classes (an experimental study). Dirasat: Educational Sciences, 35(1), 25-36.

Abstract: This study was indented to examine the effects of the concept map as an advance organizer on the forth year students' immediate and delayed achievement in education classes, at the Islamic and Arabic Studies College in Dubai. The random sample consisted of (100) males and females, (68) females and (32) males. A multiple choice achievement test of (30) items was developed by the researcher. Its validity and reliability were established. T-test was applied in analyzing the data. Findings revealed that the experimental groups (males and females) performed significantly better in the immediate and delayed achievement, than the control groups. Moreover, significant difference due to sex was found in favor of the female experimental group. Finally, some recommendations and suggestions were introduced for those concerned in the area of university teaching and further research.

Hilbert, T. S., & Renkl, A. (2008). Concept mapping as a follow-up strategy to learning from texts: What characterizes good and poor mappers? Instructional Science, 36(1), 53-73.

doi: http://dx.doi.org/10.1007/s11251-007-9022-9
Abstract: Concept maps consist of nodes that represent concepts and links that represent relationships between concepts. Various studies have shown that concept mapping fosters meaningful learning. However, little is known about the specific cognitive processes that are responsible for such mapping effects. In a thinking-aloud study, we analyzed the relations between cognitive processes during concept mapping as well as the characteristics of the concept maps that the learners produced and learning outcomes (38 university students). To test whether differences in learning outcome are due to differences in general abilities, verbal and spatial abilities were also assessed. In a cluster-analysis two types of ineffective learners were identified: 'non-labeling mappers' and 'non-planning mappers'. Effective learners, in contrast, showed much effort in planning their mapping process and constructing a coherent concept map. These strategies were more evident in students with prior concept-mapping experience ('advanced beginners') than in those who had not used this learning strategy before ('successful beginners'). Based on the present findings, suggestions for a direct training approach (i.e., strategy training with worked-out examples) and an indirect training approach (i.e., supporting the learners with strategy prompts) were developed.

Tseng, S., Sue, P., Su, J., Weng, J., & Tsai, W. (2007). A new approach for constructing the concept map. Computers & Education, 49(3), 691-707.
doi: http://dx.doi.org/10.1016/j.compedu.2005.11.020
Abstract: In recent years, e-learning system has become more and more popular and many adaptive learning environments have been proposed to offer learners customized courses in accordance with their aptitudes and learning results. For achieving the adaptive learning, a predefined concept map of a course is often used to provide adaptive learning guidance for learners. However, it is difficult and time consuming to create the concept map of a course. Thus, how to automatically create a concept map of a course becomes an interesting issue. In this paper, we propose a Two-Phase Concept Map Construction (TP-CMC) approach to automatically construct the concept map by learners' historical testing records. Phase 1 is used to preprocess the testing records; i.e., transform the numeric grade data, refine the testing records, and mine the association rules from input data. Phase 2 is used to transform the mined association rules into prerequisite relationships among learning concepts for creating the concept map. Therefore, in Phase 1, we apply Fuzzy Set Theory to transform the numeric testing records of learners into symbolic data, apply Education Theory to further refine it, and apply Data Mining approach to find its grade fuzzy association rules. Then, in Phase 2, based upon our observation in real learning situation, we use multiple rule types to further analyze the mined rules and then propose a heuristic algorithm to automatically construct the concept map. Finally, the Redundancy and Circularity of the concept map constructed are also discussed. Moreover, we also develop a prototype system of TP-CMC and then use the real testing records of students in junior high school to evaluate the results. The experimental results show that our proposed approach is workable.

Graff, M. (2006). Constructing and maintaining an effective hypertext-based learning environment: Web-based learning and cognitive style. Education & Training, 48(2-3), 143-155. doi: http://dx.doi.org/10.1108/00400910610651773
Abstract: Purpose: This paper aims to review the literature on the utility of employing the construct of cognitive style in understanding behaviour in web-based learning environments. Design/methodology/approach: The paper initially examines whether the web architecture may be matched to an individual's cognitive style in order to facilitate learning, before progressing to assess whether different architectures influence a web users' internal representations of web-based learning systems, as measured by concept map drawings. Other issues explored are users' web navigation and users' sense of learning community when receiving instruction via web-based learning environments. Findings: The studies reviewed indicate that cognitive style is a pertinent factor for consideration when assessing the success with which users engage with web-based learning systems. Research limitations/implications: Some of the studies reviewed here are small-scale and caution is urged in generalising the findings. Practical implications: In terms of the practical implications, however, it is suggested that web-based systems should be designed with consideration to individual differences in user characteristics, as this is related to the success with which users learn, navigate and interact socially in an online environment. However, it is concluded that more research is required in order to produce general rules relating cognitive style to the use of web-based learning systems. Originality/value: The findings from the numerous studies on the implications of considering the function of individual differences in using web-based learning are notable and useful in the context of web-based instruction.

Nesbit, J. C., & Adesope, O. O. (2006). Learning with concept and knowledge maps: A meta-analysis. Review of Educational Research, 76(3), 413-448.
doi: http://dx.doi.org/10.3102/00346543076003413
Abstract: This meta-analysis reviews experimental and quasi-experimental studies in which students learned by constructing, modifying, or viewing node-link diagrams. Following an exhaustive search for studies meeting specified design criteria, 67 standardized mean difference effect sizes were extracted from 55 studies involving 5,818 participants. Students at levels ranging from Grade 4 to postsecondary used concept maps to learn in domains such as science, psychology, statistics, and nursing. Posttests measured recall and transfer. Across several instructional conditions, settings, and methodological features, the use of concept maps was associated with increased knowledge retention. Mean effect sizes varied from small to large depending on how concept maps were used and on the type of comparison treatment. Significant heterogeneity was found in most subsets.

Passmore, G. J. (2004). Extending the power of the concept map. Alberta Journal of Educational Research, 50(4), 370-390.
Abstract: This pilot study introduces a scale to assess structural knowledge in concept maps. The need to increase our understanding of structural knowledge through improved assessment is made

evident in a review of research that indicates that its quality is related to problem-solving abilities. The new scale is derived from Biggs and Collis' (1982) Structure of the Learning Outcome (SOLO) taxonomy and Rumelhart and Norman's (1978) modes of learning (structuring, accretion, and tuning). It is applied to link descriptions in an enhanced concept map structure that has been dubbed the "concept map+." Eight levels of link quality can be recognized with the new scale. This builds on the original concept map assessment scale of Novak and Gowin (1984) where just three types of link quality were acknowledged.

Chastonay, P., Papart, J. P., Laporte, J. D., Praplan, G., Brenner, E., Walker, F., Lagoutte, J. (1999). Use of concept mapping to define learning objectives in a master of public health program. Teaching and Learning in Medicine, 11(1), 21-25. Retrieved from

Abstract: In a newly developed master of public health (MPH) training program, emphasis was put on educational experimentation to enhance meaningful learning. The approach includes the systematic use of concept mapping in the training process. This article describes the technique of concept mapping as an educational tool in the particular setting of a project-based MPH program. Data for the assessment were collected from 30 students (mean age 41 yrs) enrolled at the University of Geneva between 1990 and 1995. The technique was systematically used by the students to identify learning goals while planning, implementing, and evaluating research or intervention programs. Analysis of the concept maps showed that the technique allowed students to identify learning objectives in the various fields of public health and related to the different professional functions of public health personnel. Perception assessment found that concept mapping was considered a meaningful and effective tool by most students. In particular, it was believed that the method improved the students' interdisciplinary approach to solving public health problems and facilitated discussion about projects with the teaching staff..

Novak, J. D. (1990). Concept maps and vee diagrams: Two metacognitive tools to facilitate meaningful learning. Instructional Science, 19(1), 29-52.

Abstract: Reviewed research on concept mapping and Vee diagraming from Grade 1 through university. Metacognitive learning occurs whenever a person acquires some general strategy that facilitates learning or understanding of knowledge. Concept maps are a representation of meaning or ideational frameworks specific to a domain of knowledge. Vee diagrams represent the structure of knowledge and the structural elements of new knowledge construction. Skill in using these tools takes time and overcoming ingrained habits of primarily rote-mode learning may be difficult. Rote-mode learning may be responsible for the underrepresentation of women in the sciences since females tend to play the "school game" more conscientiously. When meaningful learning was facilitated by concept maps, student anxiety levels decreased and attitudes improved.

Wiki Environment

Gielen, M., & De Wever, B. (2015). Scripting the role of assessor and assessee in peer assessment in a wiki environment: Impact on peer feedback quality and product improvement. Computers & Education, 88, 370-386.
doi: http://dx.doi.org/10.1016/j.compedu.2015.07.012
Abstract: This study investigates how an instructional intervention focused on engaging both the assessor and assessee in the peer feedback process can be advantageous for the quality of students' peer feedback and written product in a wiki-based computer-supported collaborative learning environment in the first year of higher education. The main aim was to examine the effect of structuring the role of the assessee and/or assessor by respectively providing them with a peer feedback request and/or content checklist, together with a structured peer feedback template. The present study adopted a 2 × 2 design, in which four conditions were compared: (1) a control condition, (2) a feedback request condition, (3) a content checklist condition, and (4) a combination (feedback request + content checklist) condition. Every student (N = 125) belonged to a group (n = 27) of five and had to fulfil three consecutive assignments, each consisting of writing an abstract for a scientific paper in the wiki. The results revealed that the quality of both peer feedback and the final product increased for all conditions over time, but no significant differences were found between the conditions at time 2 and time 3. However, when the role of the assessee is structured to request for particular peer feedback, this appeared to be favourable for the peer feedback scores, but only at the initial stage of performance. Building on this, limitations, practical implications, and directions for future research are presented

Martini, T. S., Rail, A., & Norton, C. (2015). Psychology students' understanding of the skill-based learning fostered through university assignments. Teaching of Psychology, 42(4), 335-338. doi: http://dx.doi.org/10.1177/0098628315603182
Abstract: We examined first-year psychology majors' (*N* = 195) beliefs about the relevance of two types of university assignments (individual essay and group wiki) and their connection to the development of career-related skills. Students reported that assignments were only somewhat relevant to their career goals, and relevance ratings were typically justified by referring to assignment features (content and type) rather than skill development. Our results suggest that it is important for faculty to be explicit with students—particularly those in the early stages of their degree—about the career-related skills that their course-based activities are intended to foster.

Song, H., Restivo, M., van, d. R., Scarlatos, L., Tonjes, D., & Orlov, A. (2015). The hidden gender effect in online collaboration: An experimental study of team performance under anonymity. Computers in Human Behavior, 50, 274-282.
doi: http://dx.doi.org/10.1016/j.chb.2015.04.013

Abstract: It has been argued that the generally positive effect that female participation exerts on team performance ceases to exist under conditions of anonymity. We evaluate this thesis in the context of an online learning environment in which the gender of fellow student team members was not disclosed to subjects. To circumvent selection effects in the composition of teams we employed an experimental design in which female and male students were randomly assigned to teams of varying gender composition. Against expectations, we find that under anonymity gender composition continues to impact team performance, with all-female teams being most productive. Counter-intuitively, this team effect occurred in our study without female students *individually* being more productive than their male counterparts. These findings indicate that the presence of females on anonymous teams can have a hidden effect on the productivity of other team members. Our results underscore that despite face-to-face interaction in higher education increasingly being substituted by Internet-enabled communication, a student's social environment continues to impact academic learning in important ways.

Jung, I., & Suzuki, Y. (2015). Scaffolding strategies for wiki-based collaboration: Action research in a multicultural japanese language program. British Journal of Educational Technology, 46(4), 829-838. doi: http://dx.doi.org/10.1111/bjet.12175

Abstract: Wikis can be used to encourage and support collaborative constructivist learning. However, their effectiveness depends upon the use of scaffolding strategies to guide the students in their use. This action research investigated three scaffolding strategies for wiki-based multicultural Japanese language learning: worked examples, grouping and peer assessment. It was found that the use of a template explaining the learning objectives and expected learning process was more effective than detailed worked examples. It was also found that heterogeneous grouping and internal and external peer review were important factors.

Biasutti, M., & EL-Deghaidy, H. (2015). Interdisciplinary project-based learning: An online wiki experience in teacher education. Technology, Pedagogy and Education, 24(3), 339-355. doi: http://dx.doi.org/10.1080/1475939X.2014.899510

Abstract: In the current research study the use of Wikis as an online didactic tool to apply project-based learning in higher education was reported. The study was conducted in university teacher education programmes. During the online activities, participants developed interdisciplinary projects for the primary school working collaboratively in small groups in a Wiki virtual environment within the Moodle platform. Science was at the core of the projects and acted as an organising hub to finding links with other disciplines. A mixed-methods approach involving the collection of both quantitative and qualitative data was adopted in the current research study. The authors developed the following three instruments in order to measure both processes and outcomes of the online activities: the interdisciplinary project-based learning questionnaire, the reflection questionnaire and a rubric for assessing interdisciplinary projects. The current paper focuses only on the qualitative data, which were subjected to an inductive content analysis. Results provided evidence of the processes involved

during the collaborative activities and that online activities can develop teachers' abilities to design projects in interdisciplinary contexts. The discussion highlights the aspects of the online environment that made the collaborative work effective in learning.

Zheng, B., Niiya, M., & Warschauer, M. (2015). Wikis and collaborative learning in higher education. Technology, Pedagogy and Education, 24(3), 357-374. doi: http://dx.doi.org/10.1080/1475939X.2014.948041

Abstract: While collaborative learning and collaborative writing can be of great value to student learning, the implementation of a technology-supported collaborative learning environment is a challenge. With their built-in features for supporting collaborative writing and social communication, wikis are a promising platform for collaborative learning; however, wiki-supported collaborative learning cannot function without an effective learning design. This article highlights theory and prior research on wiki use in education and uses a design-based approach to develop strategies for using wikis to support collaborative learning in a classroom environment. In order to explore and refine these strategies, an iterative, design-based research method is used to create wiki-supported collaborative classroom activities. The authors discuss the design approach as it relates to wikis and consider the strategies that develop over four design iterations, including suggestions for learning community management, inquiry-based topic selection, teacher scaffolding, student evaluation and supporting wiki technology with other social media. This study demonstrates that while wikis can be a tool for post-secondary collaborative learning, appropriate pedagogical supports are required for successful implementation.

Heidrich, B., Kása, R., Shu, W., & Chandler, N. (2015). Worlds apart but not alone: How wiki technologies influence productivity and decision-making in student groups. Decision Sciences Journal of Innovative Education, 13(2), 221-246. doi: http://dx.doi.org/10.1111/dsji.12062

Abstract: Regardless of the size of an organization, collaboration has become a fundamental element with regard to engagement between the organization and internal and external stakeholders. With the rapid advance of communication technologies and the free-flow of information, the concept of collaboration extends beyond physical locations and time zones in the form of globally connected virtual teams. This study considers how modern Web 2.0-based collaborative technologies (wikis) relate to higher decision quality and productivity, and identifies if these collaborative technologies are better suited to tasks requiring extensive asynchronous collaboration in an educational setting. Controlled experiments involving student teams that worked in technologically and demographically diverse groups showed that wiki technologies do not suit all kinds of tasks, and do not always increase productivity or the decision quality of team collaboration.

Gan, B., Menkhoff, T., & Smith, R. (2015). Enhancing students' learning process through interactive digital media: New opportunities for collaborative learning. Computers in Human Behavior, doi: http://dx.doi.org/10.1016/j.chb.2014.12.048

Abstract: In this paper, we describe and review several examples of web technology-enabled teaching and learning approaches at undergraduate level in an Asian institution of higher learning. We begin by reporting on experiences made in the context of an iPad-enabled mobile learning project conducted during a Knowledge Management course (excursion) in support of the university's technology-enabled learning vision. This is followed by reflections on the deployment of a collaborative social learning platform website (Edmodo), wiki- and web page-creation tools (Google Site), animated videos, etc. in elective courses on leadership and human capital management. Finally, we describe a proven project-based learning approach adopted annually by numerous undergraduate teams of four to six students as part of their compulsory capstone course in the field of information systems. Besides documenting the multiple opportunities which interactive digital technologies offer for both instructors and students in order to learn collaboratively, we discuss some of the challenges when it comes to implementing and institutionalising technology-enabled teaching and learning in higher education.

Kim, N. (2015). Critical thinking in wikibook creation with enhanced and minimal scaffolds. Educational Technology Research and Development, 63(1), 5-33.
doi: http://dx.doi.org/10.1007/s11423-014-9361-6

Abstract: The purpose of the study was to investigate how to scaffold students' critical thinking skills in the process of co-writing and co-reflection of wikibooks in formal learning contexts. To observe critical thinking skills in wiki collaborations under different levels of instructional guidance, two graduate wikibook projects were : an enhanced scaffolding case (ESC) which involved structured wikibook guidelines and critical feedback exercises, and a minimal scaffolding case (MSC) which involved only basic wikibook guidelines. Quantitative and qualitative data analysis methods were adopted to compare students' perceived and observed levels of critical thinking and participation in wikibook creation. Results showed that participants in the ESC displayed relatively higher critical thinking levels as wikibook authors and peer editors. Participants in the MSC displayed relatively lower critical thinking levels, but showed more active participation in terms of the frequencies of words edited in wikibook chapters. As peer editors, however, students in both cases tended to show low levels of critical thinking and participate passively even though they considered wikibooks to be a useful online collaboration tool. Document and interview analyses revealed that MSC students experienced difficulties developing their wikibooks due to the lack of instructional assistance and displayed more trial and error, which led to their low critical thinking levels and high participation levels. One student with expertise in wikis dominated peer editing in the MSC group, but the ESC group had relatively even contributions among peers in critical thinking and participation because enhanced scaffolding was more effective for those who did not have prior knowledge and experience in wikis or editing.

Rogerson-Revell, P. (2015). Constructively aligning technologies with learning and assessment in a distance education master's programme. Distance Education, 36(1), 129-147.

doi: http://dx.doi.org/10.1080/01587919.2015.1019972
Abstract: This paper reports on an action research study investigating the use of online learning activities or "e-tivities" to enhance the learning and assessment experience of students on a distance master's programme. The study suggests that to be successfully integrated in a programme, such activities need to be carefully aligned with learning outcomes and assessment practices, and their value needs to be clear both to students and staff. The paper describes how e-tivities were designed, adopting a constructive alignment approach, to introduce more flexible and innovative approaches to learning and assessment. The e-tivities used a range of technologies (e.g., voice-based discussion boards, podcasts, wikis and blogs) to carry out group-based reflective activities. The study provides some evidence that such e-tivities, particularly voice-based activities, can help provide earlier, more detailed formative assessment, stimulate a more collaborative approach to learning and motivate students to engage more broadly with course content.

Buchanan, T., Joban, S., & Porter, A. (2014). Internet self-efficacy does not predict student use of internet-mediated educational technology. Research in Learning Technology, 22
doi: http://dx.doi.org/10.3402/rlt.v22.19585
Abstract: Two studies tested the hypothesis that use of learning technologies among undergraduate psychology students was associated with higher Internet self-efficacy (ISE). In Study 1, the ISE scores of 86 students were found not to be associated with either attitudes towards, or measured use of, blogs and wikis as part of an IT skills course. ISE was associated with time spent online, and positive attitudes to wikis were associated with higher use. Study 2 measured 163 students' ISE scores at the beginning and end of the same course. ISE was again not correlated with attitudes towards, or actual measured use of, learning technologies used in the course. However, ISE was shown to increase during the course. Positive attitudes towards wikis and discussion boards were associated with higher use of each. Overall, ISE scores did not influence measured use of a Virtual Learning Environment (VLE, including blogs, wikis and a discussion board), or attitudes towards those technologies. This implies that while ISE is linked to aspects of online behaviour (time spent online) and can be modified by online activity or training, it does not predict student use of educational Internet technologies.

Stafforda, T., Elguetab, H., & Cameron, H. (2014). Students' engagement with a collaborative wiki tool predicts enhanced written exam performance. Research in Learning Technology, 22
Abstract: We introduced voluntary wiki-based exercises to a long-running cognitive psychology course, part of the core curriculum for an undergraduate degree in psychology. Over 2 yearly cohorts, students who used the wiki more also scored higher on the final written exam. Using regression analysis, it is possible to account for students' tendency to score well on other psychology exams, thus statistically removing some obvious candidate third factors, such as general talent or enthusiasm for psychology, which might drive this correlation. Such an analysis shows that both high- and low-grading students who used the wiki got higher scores on the final exam, with engaged wiki users

scoring an average of an extra 5 percentage points. We offer an interpretation of the mechanisms of action in terms of the psychological literature on learning and memory.

Katz, B. P., & Thoren, E. (2014). WikiTextbooks: Designing your course around a collaborative writing project. PRIMUS: Problems, Resources, and Issues in Mathematics Undergraduate Studies, 24(7), 574-593. doi: http://dx.doi.org/10.1080/10511970.2013.843625
Abstract: We have used wiki technology to support large-scale, collaborative writing projects in which the students build reference texts (called WikiTextbooks). The goal of this paper is to prepare readers to adapt this idea for their own courses. We give examples of the implementation of WikiTextbooks in a variety of courses, including lecture and discovery-based courses. We discuss the kinds of challenges that WikiTextbooks address and focus on critical design decisions. Finally, we conclude with a suggested template wiki project that is approachable for new users and appropriate for many course structures.

Newland, B., & Byles, L. (2014). Changing academic teaching with web 2.0 technologies. Innovations in Education and Teaching International, 51(3), 315-325. doi: http://dx.doi.org/10.1080/14703297.2013.796727
Abstract: Academic teaching can change with the use of Web 2.0 technologies, such as blogs and wikis, as these enable a different pedagogical approach through collaborative learning and the social construction of knowledge. Student expectations of their university learning experience have changed as they expect e-learning to be part of the learning experience. The Innovative eLearning with eResources (eRes) project aimed to provide a sustainable, scalable approach to changing academic practice. The approach built on academic's experience of using quality e-resources in research and for their reading lists in teaching. The eRes project was successful as student learning was enhanced through collaborative learning using quality e-resources with Web 2.0 technologies. However, two keys issues were identified. The first issue is the lack of scalability of the approach due to the high level of support required from a team of pedagogical and technical specialists brokered through an individual. The second issue is academic professional development. Academics recognised their professional development requirements in relation to technology but they did not identify the need to change their pedagogical approach for collaborative learning with Web 2.0.

Underwood, J. D. M., & Stiller, J. (2014). Does knowing lead to doing in the case of learning platforms? Teachers and Teaching: Theory and Practice, 20(2), 229-246. doi: http://dx.doi.org/10.1080/13540602.2013.848569
Abstract: There have been significant advance in educational technology but they have not always brought about measurable shifts in user behavior. This study examined the relationship between teachers' knowledge about a tool and their use of that tool. In many secondary schools use of a Learning Platforms (LPs) is no longer optional although the degree of engagement with the technology remains a matter of choice. However, individual decisions to use selected functionalities

of these systems are not well captured in current models of technology acceptance. In a best-case scenario, self-reported possible and actual use of LPs was acquired for 50 teachers from eight technology-rich schools. Three key barriers to use were identified: the functionality of the software, workloads and personal interest. Based on teachers' knowledge of LP functionality and perceived barriers to use, four distinct groups of teachers emerged. A low-user group identified all three barriers, showed little enthusiasm for use of this technology and had a markedly impoverished perception of the LP. There were three distinct higher use groups based on perceived barriers. While the functions used by these three groups showed less variation, with innovative functions such Blogs and Wikis remaining aspirational, there were differences in how such limitations were viewed. Whether the response was one of complacency and frustration has implications for professional development programmes.

Kennedy, C., & Miceli, T. (2013). In piazza online: Exploring the use of wikis with beginner foreign language learners. Computer Assisted Language Learning, 26(5), 389-411. doi: http://dx.doi.org/10.1080/09588221.2013.770035

Abstract: Wikis are increasingly seen as useful tools for promoting active student engagement and collaborative language learning. Unlike most applications of wikis to foreign/second language learning thus far reported on, ours concerns complete beginners. In this paper, we focus on our approach to and evaluation of the integration of wikis into our first-year Italian course with the aim of encouraging out-of-class practice and fostering students' sense of class community, right from the start of their learning. The evaluation showed that, although the students created several attractive and interesting pages, they did not appreciate the wikis as much as we had hoped: there were technical hitches, many found collaboration dynamics challenging, and most developed little interest in participating in a cross-campus online group. Our data analysis found no relationship between the students' perceptions of the wiki work and their gender, initial confidence or frequency of use of computer-mediated communication (CMC) tools. However, those who, on entering the course, placed greater importance on interaction with other students, and a sense of community in class, showed greater appreciation of the wiki experience. From these findings, we draw implications for improving our approach to integrating wiki work into our program.

Roussinos, D., & Jimoyiannis, A. (2013). Analysis of students' participation patterns and learning presence in a wiki-based project. Educational Media International, 50(4), 306-324. doi: http://dx.doi.org/10.1080/09523987.2013.863471

Abstract: The educational applications of wikis are becoming very popular among instructors and researchers and they have captured their attention and imagination. This paper reports on the investigation of a wiki project designed to support university students' collaborative authoring and learning. The design framework of the wiki-based project is outlined and an analysis framework is proposed as the result of combining analysis of students' collaborative actions, e.g. edits and posts in the wiki pages. The framework was applied to investigate students' engagement, their contribution to

the wiki content and the patterns of collaboration and content co-creation they followed during the project timeline. Our findings revealed different patterns of students' contribution to their group wiki as well as their different roles. The paper concludes with suggestions for future development of the framework and research in the field of wiki learning design.

Castañeda, D. A., & Cho, M. (2013). The role of wiki writing in learning spanish grammar. Computer Assisted Language Learning, 26(4), 334-349.
doi: http://dx.doi.org/10.1080/09588221.2012.670648
Abstract: The purpose of this study was to investigate the extent to which wiki writing improves college students' grammatical knowledge in Spanish as a second language (L2). Fifty-three students participated in the study for three consecutive semesters. Pre- and posttest results show that wiki writing was helpful in improving their grammatical knowledge. In addition, students found designed wiki writing useful and helpful for developing their writing skills and L2 learning; however, they felt uncomfortable editing other students' writing and doubted the accuracy of others' editing. Discussion and implications for using wiki writing are provided.

Archambault, P. M., van, d. B., Grajales,Francisco J., I.,II, Faber, M. J., Kuziemsky, C. E., Gagnon, S., Légaré, F. (2013). Wikis and collaborative writing applications in health care: A scoping review. Journal of Medical Internet Research, 15(10), 4-38.
doi: http://dx.doi.org/10.2196/jmir.2787
Abstract: Background: Collaborative writing applications (eg, wikis and Google Documents) hold the potential to improve the use of evidence in both public health and health care. The rapid rise in their use has created the need for a systematic synthesis of the evidence of their impact as knowledge translation (KT) tools in the health care sector and for an inventory of the factors that affect their use. Objective: Through the Levac six-stage methodology, a scoping review was undertaken to explore the depth and breadth of evidence about the effective, safe, and ethical use of wikis and collaborative writing applications (CWAs) in health care. Methods: Multiple strategies were used to locate studies. Seven scientific databases and 6 grey literature sources were queried for articles on wikis and CWAs published between 2001 and September 16, 2011. In total, 4436 citations and 1921 grey literature items were screened. Two reviewers independently reviewed citations, selected eligible studies, and extracted data using a standardized form. We included any paper presenting qualitative or quantitative empirical evidence concerning health care and CWAs. We defined a CWA as any technology that enables the joint and simultaneous editing of a webpage or an online document by many end users. We performed qualitative content analysis to identify the factors that affect the use of CWAs using the Gagnon framework and their effects on health care using the Donabedian framework. Results: Of the 111 studies included, 4 were experimental, 5 quasi-experimental, 5 observational, 52 case studies, 23 surveys about wiki use, and 22 descriptive studies about the quality of information in wikis. We classified them by theme: patterns of use of CWAs (n = 26), quality of information in existing CWAs (n = 25), and CWAs as KT tools (n = 73). A high prevalence of CWA use (ie, more than 50%) is

reported in 58% (7/12) of surveys conducted with health care professionals and students. However, we found only one longitudinal study showing that CWA use is increasing in health care. Moreover, contribution rates remain low and the quality of information contained in different CWAs needs improvement. We identified 48 barriers and 91 facilitators in 4 major themes (factors related to the CWA, users' knowledge and attitude towards CWAs, human environment, and organizational environment). We also found 57 positive and 23 negative effects that we classified into processes and outcomes. Conclusions: Although we found some experimental and quasi-experimental studies of the effectiveness and safety of CWAs as educational and KT interventions, the vast majority of included studies were observational case studies about CWAs being used by health professionals and patients. More primary research is needed to find ways to address the different barriers to their use and to make these applications more useful for different stakeholders.

Blau, I., Mor, N., & Neuthal, T. (2013). Interacting for learning: Digital portfolios for a learning community in a university course. Learning, Media and Technology, 38(3), 241-255. doi: http://dx.doi.org/10.1080/17439884.2012.709864

Abstract: This study investigates student interactions in a blog-based learning community in a university course. In addition, this study explores the dynamics of group interactions in individual blog-based environments compared with collaborative *wiki*-based educational activities. A learning community of 56 graduate students wrote individual blogs and weekly group summaries using a *wiki* environment. The posts were analyzed by identifying a post content type and explicit feedback promotions, and by counting the number of the blogger's own comments and the number of others' comments per post, received from peers studying in the same versus the other offline group. The results show that choosing the appropriate type of post content (i.e., sharing experiences rather than providing information, explicitly calling for feedback, and providing the blogger's own comments) augments peer interaction in a blog environment, thus explaining 51.4% of variance in peer comments. Group interactions through comments in individual blogs, without the possibility of changing one another's content, seem to be non-intrusive and prompt interactions with offline as well as with online peers. In contrast, actual editing of texts through multi-authored collaborative *wikis* remained affected by student offline former acquaintance. The results are discussed in terms of social interactions and pedagogical beliefs.

Tomei, L. A. (2013). Top 10 technologies for designing 21st century instruction. International Journal of Information and Communication Technology Education, 9(3), 80-93. doi: http://dx.doi.org/10.4018/jicte.2013070106

Abstract: Faculties at all levels of education continue to ask, "How does technology fit into my teaching?" How can I teach my students to become technologically literate?" For some, the answers seem quite simple. Technology should be integrated into as many levels of the curriculum as possible. If we aspire to prepare students for the future, teachers must seize every opportunity to infuse the technologies their students will be using whenever possible. The key is to know what works best in

each classroom situation. Podcasting, interactive whiteboards, blogs, wikis, social networking, virtual classrooms, and others are the latest in instructional technologies. Teachers use these tools to address the growing inventory of requisite 21st century skills that include: global awareness, self-directed learning, ICT literacy, problem solving skills, time management and personal responsibility, lifelong learning, financial, economic, business and entrepreneurial literacies, communications, collaboration, and more. This article explores best practices that lead to change and shares ideas about the use of these tools in the classroom. Emphasis is placed on many real-world examples of how technology has improved teaching and learning. This information paper will examine the hardware and software aspects of the following technologies: interactive white boards, web cameras, videoconferencing, iPods, digital cameras, digital video, wikis and blogs, social networking, digital electronic books, and student response systems. While the paper is not a scholarly endeavor, it is hoped that the review of important teaching and learning tools will provide the reader with an update on the latest in instructional technologies for the classroom. In addition to an introduction that includes a description of the technology, its primary features, advantages and disadvantages, there are links to online videos demonstrating each technology that bear witness to how these technologies actually impact the classroom. Finally, a link to current research pertaining to each technology is offered.

Wichadee, S. (2013). Improving students' summary writing ability through collaboration: A comparison between online wiki group and conventional face-to-face group. TOJET: The Turkish Online Journal of Educational Technology, 12(3), 107-116.

Abstract: Wikis, as one of the Web 2.0 social networking tools, have been increasingly integrated into second language (L2) instruction to promote collaborative writing. The current study examined and compared summary writing abilities between students learning by wiki-based collaboration and students learning by traditional face-to-face collaboration. The experimental research was conducted with students enrolled in EN 111 course in the first semester of academic year 2011. The instruments employed in the study were summary writing tests, a questionnaire, and products of summary writing. Data were analyzed by using means, standard deviations, percentages, and t-tests. The results indicate that the post-test scores of both groups were significantly higher than the pre-test scores. ($p < .05$). However, no significant difference was found between the two groups' writing mean scores and satisfaction with the learning methods. In addition, the writing products which students in both groups submitted were not different in quality. Although there were minor drawbacks, a lot of advantages were identified, showing students' positive attitudes towards learning through wiki.

Caple, H., & Bogle, M. (2013). Making group assessment transparent: What wikis can contribute to collaborative projects. Assessment & Evaluation in Higher Education, 38(2), 198-210. doi: http://dx.doi.org/10.1080/02602938.2011.618879

Abstract: This paper investigates the use of new media technologies, in particular wikis, for the compiling and grading of group assessment tasks. Wikis are open web pages that can be viewed and modified by anyone with internet access and are well known for their collaborative nature. Wikis are

also transparent, which means that any edit/modification is recorded and attributed to a specific user. Such transparency has immense implications for the assessment of group work, as one of the major criticisms of group assessment tasks made by students relates to fairness in the distribution of grades. Therefore, the aims of this paper are to examine whether a wiki can help make the grading of group work fairer and whether the wiki environment encourages students to engage more directly with the contributions of other group members, thereby making it a truly collaborative experience.

Wichmann, A., & Rummel, N. (2013). Improving revision in wiki-based writing: Coordination pays off. Computers & Education, 62, 262-270.
doi: http://dx.doi.org/10.1016/j.compedu.2012.10.017
Abstract: Wiki-based writing possesses a great deal of educational potential, yet students face difficulties while writing a shared document. Revising a shared document, in particular, seems to be a demanding activity for students. This study investigated whether collaboration scripts can help to improve students' revision activities and overall text quality. We compared scripted (script+) with unscripted (script−) collaboration in a wiki-based writing setting that was adapted for educational purposes. Students from two university courses participated in a one-week collaborative writing activity. Results showed that students in the scripted condition outperformed students in the unscripted condition with respect to revision behavior and text coherence. Furthermore, we found that students' revision behavior correlated positively with text coherence. Results from analyzing students' discussions during the writing activity revealed more frequent coordination with respect to task division and increased communication frequency for students in the scripted condition. Results also indicate that collaboration scripts can foster coordination. Our findings suggest that collaboration scripts are promising means of structuring collaboration during wiki-based writing.

Matschke, C., Moskaliuk, J., & Kimmerle, J. (2013). The impact of group membership on collaborative learning with wikis. Cyberpsychology, Behavior, and Social Networking, 16(2), 127-131.
Abstract: The social web stimulates learning through collaboration. However, information in the social web is often associated with information about its author. Based on previous evidence that ingroup information is preferred to outgroup information, the current research investigates whether group memberships of wiki authors affect learning. In an experimental study, we manipulated the group memberships (ingroup vs. outgroup) of wiki authors by using nicknames. The designated group memberships (being fans of a soccer team or not) were completely irrelevant for the domain of the wiki (the medical disorder fibromyalgia). Nevertheless, wiki information from the ingroup led to more integration of information into prior knowledge as well as more increase of factual knowledge than information from the outgroup. The results demonstrate that individuals apply social selection strategies when considering information from wikis, which may foster, but also hinder, learning and collaboration. Practical implications for collaborative learning in the social web are discussed.

Rasmussen, A., Lewis, M., & White, J. (2013). The application of wiki technology in medical education. Medical Teacher, 35(2), 109-114.
doi: http://dx.doi.org/10.3109/0142159X.2012.733838
Abstract: Background, aims and methods: Recent years have seen the introduction of web-based technologies such as the 'wiki', which is a webpage whose content can be edited in real time using a web browser. This article reviews the current state of knowledge about the use of wikis in education, and considers whether wiki technology has features that might prove useful in medical education. Results: Advantages and challenges of the technology are discussed, and recommendations for use are provided. We believe that wiki technology offers a number of potential benefits for administrators, students and instructors, including the ability to share information online, to construct knowledge together, to facilitate collaboration and to enable social learning and peer feedback. Conclusions: We believe that with proper planning and instructional design, wiki technology can be usefully employed in medical education. We intend to continue to study the impact of wiki technology in our own programme, and we encourage others to evaluate the application of wiki technology in other areas of medical education.

Lo, H. (2013). Design of online report writing based on constructive and cooperative learning for a course on traditional general physics experiments. Journal of Educational Technology & Society, 16(1), 380-391.
Abstract: The objective of this study was to develop an online report writing activity that was a constructive and cooperative learning process for a course on traditional general physics experiments. Wiki, a CMC authoring tool, was used to construct the writing platform. Fifty-eight undergraduate students (33 men and 25 women), working in randomly assigned groups of 2 to 3 members, participated in this course. Both quantitative and qualitative data, including assessments of reports, questionnaires, interviews, and records of discussion on wiki, were collected and analyzed to investigate the course design of online report writing. Results showed that students recalled, discussed, searched for, and integrated auxiliary information, reflected on the experiment, and shared meaning in the process of online writing. Evidence of positive interdependence, promotive interaction, individual accountability, social skills, and group processing proved that students worked cooperatively to accomplish shared learning goals. A higher average score of online writing than that of traditional paper writing indicated that students wrote online reports better, compared to the traditional method. Student participants and the instructor in the course responded positively when they were questioned on their perceptions of the Wiki-based report writing.

Daspit, J. J., & D'Souza, D. E. (2012). Using the community of inquiry framework to introduce wiki environments in blended-learning pedagogies: Evidence from a business capstone course. Academy of Management Learning & Education, 11(4), 666-683.
doi: http://dx.doi.org/10.5465/amle.2010.0154

Abstract: In an increasingly digital society, educators are encouraged to use on-line technologies. However, much is left to be learned about how on-line tools influence student learning. In this manuscript, we use the community of inquiry (Col) framework to examine the contribution of one on-line tool, a wiki, to a blended-learning course. Structural modeling techniques are used to analyze data collected from students in an undergraduate business capstone course. The results suggest that teaching presence, social presence, and cognitive presence (components of the community of inquiry framework) exist in a wiki environment in a manner similar to other on-line environments. Additionally, teaching presence and social presence are shown to influence cognitive presence (e.g., learning), which reaffirms that the role of the instructor continues to be paramount to student learning in technology-enhanced environments. Given that the Col framework is a novel conceptualization recently introduced to the management education literature, we offer theoretical recommendations for researchers and practical recommendations for instructors interested in incorporating wiki technology in a blended-learning pedagogy. We believe our findings provide fresh insights on, and new possibilities for, instructional development in business education.

Ioannou, A., & Stylianou-Georgiou, A. (2012). Mashing-up wikis and forums: A case study of collaborative problem-based activity. Educational Media International, 49(4), 303-316. doi: http://dx.doi.org/10.1080/09523987.2012.741201

Abstract: A lot of studies have investigated the isolated use of threaded discussion and wiki technologies to facilitate collaboration in online learning settings. Nevertheless, the integration of both technologies into a potentially superior collaborative learning tool has not been explicitly investigated. This manuscript reports on an effort to undertake the merging and cooperation of wiki and threaded discussion technologies into a more sophisticated technology that better supports collaboration during problem-based activity in computer supported collaborative learning (CSCL) settings. Two customized collaboration technologies were investigated for their affordances to support students' cognitive processes and interactions during the construction of a group solution to an authentic problem. We found that one technology—WikiSplit—was particularly successful in promoting diversity of ideas (forum mode) while allowing learners to periodically update a group-owned document with syntheses of their emerging and shared understandings (wiki mode). We discuss how the integrated use of both a forum and a wiki, packaged together as one tool, can support and mediate desirable CSCL interactions during problem-based activity.

Waldeck, J. H., & Dougherty, K. (2012). Collaborative communication technologies and learning in college courses: Which are used, for what purposes, and to what ends? Learning, Media and Technology, 37(4), 355-378. doi: http://dx.doi.org/10.1080/17439884.2011.592497

Abstract: Web-based communication technologies that enable collaboration and sharing of information among users—such as podcasts, wikis, blogs, message boards, and others—are used commonly in contemporary organizations to increase and manage employee learning. In this investigation, we identify which of these collaborative communication technologies are used in

relation to college courses, and with what frequency; we report student evaluations of their use and reasons why students indicate using them. Next, using Keller's *ARCS* theoretical framework, we examine the role of course-related communication technology use in four dimensions of course-specific motivation. Results indicate that in courses where students perceive that technology is used effectively, motivation to learn is higher than in courses where students perceive technology is used ineffectively—and that technology-related motivation is substantially related to course-specific learning outcomes. Importantly, students reported higher levels of cognitive learning for courses in which technology was perceived as being used effectively than for courses in which communication technology was perceived by students as ineffectively implemented.

Biasutti, M., & EL-Deghaidy, H. (2012). Using wiki in teacher education: Impact on knowledge management processes and student satisfaction. Computers & Education, 59(3), 861-872.

Abstract: The current study reports on the use of Wiki as an online didactic tool to develop knowledge management (KM) processes in higher education. This study integrates social constructivist principles to learning where learners are pro-active and collaborative through higher order cognitive processes. The study was administered in two countries, namely Egypt and Italy, to close a gap in the literature with an aim to introduce KM processes in teacher educational programmes. These processes are seen as necessary for teachers' professional skills. Such processes are claimed to enable teachers and therefore schools to evolve in a networked information-driven global society, especially as the complexity of subject knowledge is increasing. It is also a learning experience where teachers learn how to provide their students with educational settings where technology is enabled. Throughout the study, 27 Egyptian students and 36 Italian students participated in online activities and developed interdisciplinary projects for the primary and preparatory stages while collaborating in a Wiki experience within Moodle platform. The study followed a mixed methods approach that consisted of both quantitative and qualitative data. The authors developed several instruments in order to measure both processes and outcomes of the five-week online activities. This current study is reporting on the use of two closed question instruments and one open question instrument. These were: Knowledge Management Questionnaire (KMQ), Student Satisfaction Questionnaire (SSQ) and a Reflection Questionnaire (RQ). Data were analysed using statistical analysis and inductive content analysis. Results indicate that responses on the KMQ were all reliable >0.70, and fulfilled the five processes of KM and participants were highly satisfied. The results suggest that Wikis can develop teachers' knowledge management processes and fulfil student's satisfaction while collaborating in designing interdisciplinary projects. Future implications and suggestions for teacher education programmes are provided in light of the findings.

Milovanović, M., Minović, M., Štavljanin, V., Savković, M., & Starčević, D. (2012). Wiki as a corporate learning tool: Case study for software development company. Behaviour & Information Technology, 31(8), 767-777. doi: http://dx.doi.org/10.1080/0144929X.2011.642894

Abstract: In our study, we attempted to further investigate how Web 2.0 technologies influence workplace learning. Our particular interest was on using Wiki as a tool for corporate exchange of knowledge with the focus on informal learning. In this study, we collaborated with a multinational software development company that uses Wiki as a corporate tool since 2001. For our research, we used three different sources for acquisition of data. Primarily, we did an interview with top management. Next we acquired the data on usage statistics from the company Wiki. And finally we distributed a questionnaire in order to acquire users' feedback. Analysis provided many interesting results. One of the main conclusions is that Wiki is successfully used in this company, and large majority of employees finds it useful. Additionally, Wiki did aid informal learning, but there is still plenty of room for improvement.

Kim, H. J., Miller, H. R., Herbert, B., Pedersen, S., & Loving, C. (2012). Using a wiki in a scientist-teacher professional learning community: Impact on teacher perception changes. Journal of Science Education and Technology, 21(4), 440-452.
doi: http://dx.doi.org/10.1007/s10956-011-9336-x

Abstract: In this study, a wiki was integrated into a professional development model that systemically addresses early-career teachers' needs. This study was conducted to examine the impact of wiki-based professional development activities in a scientist-teacher professional learning community and focused on early-career teachers' perceptions of the role of wiki technology and knowledge of teaching through inquiry. Teachers participated in the Professional Learning Community Model for Entry into Teaching Science (PLC-METS), a professional development program that is based on an integrated teacher education model of knowledge sharing, collaboration, and communication between teachers and scientists, with the goal of supporting early-career teachers' ability to engage their students in scientific inquiry. The use of a wiki environment to collaborate on activities, deliver resources, and share knowledge is rapidly expanding in professional development communities. The use of the wiki in PLC-METS positively predicted the results of teachers' knowledge of inquiry-based teaching. Results demonstrate that the wiki can contribute to building a learning community for collaboration between early-career science teachers and scientists. The paper also discusses the educational implications for the design of wiki-based professional learning communities that impact teachers' professional development.

Keengwe, J., & Schnellert, G. (2012). Fostering interaction to enhance learning in online learning environments. International Journal of Information and Communication Technology Education, 8(3), 28-35.

Abstract: Interaction Is central to educational experiences in online learning environments. Interaction enhances learning by fostering three types of learning interaction: learner-instructor, learner-learner and learner-content. Additionally, online students generally perceive interaction as an effective means of learning. Therefore, it is important for online Instructors to create opportunities for interaction in online learning environments. This article stimulates reflections on the critical role

of interaction in online learning. A primary implication based on the challenges reported in the study is that instructors need to reflect on effective ways to design and implement successful online learning environments. For instance, instructors could anticipate these challenges by focusing on the development of online tools such as wikis to enhance effective online interaction.

Loureiro, M. J., Pombo, L., & Moreira, A. (2012). The quality of peer assessment in a wiki-based online context: A qualitative study. Educational Media International, 49(2), 139-149. doi: http://dx.doi.org/10.1080/09523987.2012.703426

Abstract: Peer assessment (PA) provides opportunities for authentic assessment, autonomy and collaboration. Several authors advocate that students can benefit from PA and put forward the effects of PA on the students' learning outcomes. Questions concerning the validity and reliability of PA and PA competences are also addressed by different researchers. This qualitative study is part of a wider project that seeks to develop and test evaluation and assessment strategies in online contexts. In a doctoral module, PA was used for summative and formative purposes. Formative PA aimed to give feedback about the ongoing group work, but also to increase online interaction between the different groups of students. The main module task was to write a literature review, about a selected topic, using a wiki. Criteria and indicators to assess the literature review were negotiated with the students. Different criteria were used to assess the quality of PA, such as, the use of the negotiated criteria, the adequacy of the chosen vocabulary or the provision of constructive feedback. The results show that overall the quality of PA can be improved. Groups did not provide sufficient criticism, questions and suggestions for improvement.

Allen, M., & Tay, E. (2012). Wikis as individual student learning tools: The limitations of technology. International Journal of Information and Communication Technology Education, 8(2), 61-71. doi: http://dx.doi.org/10.4018/jicte.2012040105

Abstract: This paper presents research into the attitudes and behaviours of students using wikis for individual writing tasks. The wiki-based assignment differs from the use of wikis normally researched because it was an individual task not involving collaborative writing. This activity provides an excellent opportunity to learn more about how wikis are actually used by students in higher education. The research finds there is no compelling evidence that the wiki on its own improves performance over and above the general aptitude of students. It also finds that students generally did not utilise the wikis for high-intensity editing and revision. However, students did report that the wiki was valuable as a way of aiding them to review and develop their ideas. We conclude that using wikis for individual writing tasks can, where appropriate active instructions are given to support development of cognitive abilities, lead to improved outcomes for students.

Avci, U., & Askar, P. (2012). The comparison of the opinions of the university students on the usage of blog and wiki for their courses. Journal of Educational Technology & Society, 15(2), 194-205.

Abstract: The purpose of this study was to investigate the use of blogs and wikis as constructive tools in the computer courses of prospective teachers and compare them with respect to perceived usefulness, perceived ease of use, intention, self efficacy, and anxiety. Ninty-two students who were enrolled in various teacher education programs used blog and wiki for their courses. After their experiences with blog and wiki, the data were collected by administrating the instrument developed by the researchers. The results showed that students were positive to blog and wiki usage in the teaching-learning process. However they found wiki more useful. Both perceived usefulness and self efficacy variables explain 71% of blog and wiki usage. This value points to a very high and significant correlation. Perceived usefulness has been identified as the variable that could explain intention by itself at the most.

Koh, E., & Lim, J. (2012). Too early, too bad: Uncovering and understanding the initial participation paradox in technology-mediated learning teams. IEEE Transactions on Professional Communication, 55(1), 55-84. doi: http://dx.doi.org/10.1109/TPC.2011.2172122

Abstract: Research Problem: Time is of the essence in technology-mediated teams. However, research has been inconclusive about the impact of team participation on outcomes. A possible reason can be found in the temporal dimension; particularly, we refer to the time points examined in relation to the entirety of the period. Indeed, we can find research attention on initial participation (IP) infields such as social psychology. IP refers to the contributions of team members during the earlier half of the team's lifespan. Comparable efforts are in want in information systems contexts where the relevancy and saliency of IP is no less. Research Questions: Does IP affect outcomes of technology-mediated teams? Do team size and task type affect IP in technology-mediated teams? Literature Review:Based on a review of literature that includes group development, information overload, and integrative complexity,we discover an IP paradox. More intense IP, in terms of amount and equality, could decrease outcomes, namely, task performance, team learning, and outcome satisfaction. Moreover, two cornerstone boundary conditions of teamwork,team size and task type, could affect IP. Methodology: A quantitative field experiment with 49 technology-mediated learning teams that involved 245 participants was conducted. These teams used a wiki to complete a task in a course in higher education. Data were collected from a pretest survey, posttest survey, and electronic records of the wiki (edit count and word count). Qualitative data from participants were also sought for the sake of triangulation. The data were analyzed using partial least squares. Results and Discussion: The results show that higher IP amount and equality decreased task performance and outcome satisfaction as predicted. However, higher IP amount did not significantly affect team learning although this was significant in the hypothesized direction for IP equality. As for team size, larger team sizes increased IP amount but lowered IP equality. Task type did not affect IP amount and contrary to our prediction, multiple solution tasks instead of single solution tasks decreased IP equality. Nevertheless,the findings support the notion that higher IP leads to detrimental outcomes. This suggests the importance of coordination mechanisms in the initial period especially in time-limited teams. For instance, knowledge leaders and facilitators can step up to organize and reduce information overload during

the initial period to ensure an easier time synthesizing in the later period and better task performance. The current work was limited in terms of using only objective data for participation amount and equality. Future research could involve a combination of perceptual and objective data as well as other types of participation constructs, such as task related, norms and rules, and socioemotional acts for a richer insight into the IP paradox.

Fearon, C., McLaughlin, H., & Eng, T. Y. (2012). Using student group work in higher education to emulate professional communities of practice. Education & Training, 54(2-3), 114-125. doi: http://dx.doi.org/10.1108/00400911211210233

Abstract: Purpose: The purpose of this paper is to discuss the value of social learning from group work that emulates a professional community of practice. Design/methodology/approach: A thought piece that first, examines the role of group-work projects as part of social learning, then outlines key arguments for social learning based upon applying a "communities of practice" approach and finally, discusses the experience of a leading UK university in light of Hoadley and Kilner's "C4P" communities of practice framework. Some reflections are offered to help practitioners and academics who wish to adopt a similar approach. Findings: Developing a communities of practice approach using group work can promote social learning and workplace transferrable skills. The authors discussed five main elements of the C4P communities of practice framework in light of a group project at a leading UK university: "purpose"—to emulate an IT consultancy environment and create energy and results as part of the final year group-work project; "conversation and connections"—to promote information exchange between group members through meetings, e-mail, or wikis; "content and context"—drawing upon organisational knowledge and directing groups to improve the quality of project deliverables. Some key reflections include: emulating real world practice helps develop transferrable skills; building membership of a community through simulated teamwork roles encourages motivation; and group leadership helps achieve common purpose. Originality/value: The paper offers a unique insight and applies a communities of practice framework for analysing and developing group work as part of social learning.

Buraphadeja, V., & Kumar, S. (2012). Content analysis of wiki discussions for knowledge construction: Opportunities and challenges. International Journal of Web-Based Learning and Teaching Technologies, 7(2), 28-42.

Abstract: Research on several aspects of asynchronous online discussions in online and hybrid courses has been successfully conducted using content analysis in the past. With the increase in Web 2.0 and social media use in education, research on knowledge construction within newer virtual environments like blogs or wikis is just emerging. This study applies a well-known model of content analysis for knowledge construction to an educational wiki environment. Twelve graduate students' contributions to a wiki in a 14-week on-campus course on Web 2.0 technologies in education are analyzed. Results indicate that the wiki platform fosters collaborative knowledge construction and that is necessary to develop new frameworks to analyze content in new learning environments. Wiki

environments provide opportunities for researchers to capture the process of collaboration, knowledge construction, and meta-cognition.

Forment, M. A., De Pedro, X., Casañ, M. J., Piguillem, J., & Galanis, N. (2012). Wikis in collaborative educational scenarios: Integrated in LMS or standalone wikis? International Journal of Distance Education Technologies, 10(4), 72-81.
doi: http://dx.doi.org/10.4018/jdet.2012100106
Abstract: This article outlines a set of features that wiki engines require to successfully host collaborative educational scenarios. The authors explore multiple issues that deal with the use wikis with learning activities. One of the first issues to solve is software support for assessment methodologies. The second is choosing between using an integrated wiki engine inside the Learning Management System (LMS) or an external standalone wiki engine. Advantages and disadvantages from both options of this second issue are discussed. The different implications of each option as far as individual student assessment, feedback, and grading are concerned are also analyzed. Among the expected results, the most notable are incentives to incorporate wikis in the teaching process, significant enhancements in usability, as well as allowing teachers to provide more timely written feedback on their students' individual contributions on wiki based activities, on top of the usual numerical grading. This paper presents the conclusions of 5 years of experience of work in the field of wikis in education, development of improvements on open source wiki engines and thus, building from scratch accordingly the new wiki engine for the LMS Moodle 2.0.

Taylor, J. (2012). The assessment of critical evaluation, leadership and reflection skills through participation in online discussions. Psychology Teaching Review, 18(2), 52-58.
Abstract: Increasingly, educators from all disciplines are using blogs, social networking sites, VLEs and wikis to encourage academic discourse between students. However, a common problem experienced by educators is how these important learning experiences can be assessed and because of this difficulty many are not assessed. For some time now, I have been using online discussions via the University VLE as a way to encourage student debate around key lecture topics (e.g. Taylor, 2002). The key learning outcomes which this assessed activity addresses, in addition to learning more about the topic, are to develop skills in reflective practice, critical evaluation and leadership. This article will review the ways that face-to-face and online academic discourse between students have been assessed, highlighting some of the differences to consider when setting up online discussion activities, compared to face-to-face discussion. I will then provide a case study of the way I set up online discussions and the method I currently use to assess contributions. The final part of the paper will, consider the potential for using quantitative content analysis (QCA) and automated methods to assess online participation.

Bensona, R., Brack, C., & Samarwickrema, G. (2012). Teaching with wikis: Improving staff development through action research. Research in Learning Technology, 20(2), 1-16.

Abstract: This paper reports on the use of action research in a case study involving two iterations of an online workshop implemented at two universities in late 2007 and early 2009 to prepare teaching staff for using wikis for student group work and assessment. Workshop participants were immersed in the experience of collaborating in a wiki as learners and then reflected on this experience as teachers. Experience of the pilot workshop suggested a need for more orientation, potentially by introducing a blended learning design. The second iteration highlighted a need to develop the orientation session further and increase support strategies throughout the workshop, suggesting the value of offering it at faculty or department level if no "reward" is available for participation. Outcomes from the two cycles illustrate the value of action research for iterative improvement of this staff development model and for implementing the scholarship of teaching and learning to develop and share professional knowledge in this emerging area. This paper outlines a staff development approach involving Web 2.0 applications on which others can build.

Jenkins, M., Browne, T., Walker, R., & Hewitt, R. (2011). The development of technology enhanced learning: Findings from a 2008 survey of UK higher education institutions. Interactive Learning Environments, 19(5), 447-465.
doi: http://dx.doi.org/10.1080/10494820903484429
Abstract: This article summarises the key findings from a UK survey of higher education institutions, focusing on the development of technology enhanced learning (TEL). TEL is defined as any online facility or system that directly supports learning and teaching. The 2008 survey builds upon previous UCISA surveys conducted in 2001, 2003 and 2005 and for which at each stage after 2001, a longitudinal analysis was undertaken [see Browne, T., Jenkins, M., &Walker, R. (2006). A longitudinal perspective regarding the use of VLEs by higher education institutions in the United Kingdom. *Interactive Learning Environments, 14*(2), 177–192]. The findings, confirmed by other studies published since 2005, reveal that ensuring the quality of learning and teaching activities is consolidated as the primary driver for using TEL with a *committed local champion* representing the highest ranked factor in supporting TEL development within an institution. External strategies have been influential, contributing to the rise to prominence of institutional e-learning strategies. The delivery of course content continues to be the most common way in which TEL is used to support teaching and learning. The tools that have increased in prominence are those for podcasting, e-portfolios, e-assessment, blogs and wikis. Regarding new activities, streaming media, mobile computing, podcasting and Web 2.0 are discernibly the greatest. Upgrading staff skills were overwhelmingly noted as the greatest challenge that these new activities would create, with staff development and supportive strategies being seen as the primary remedies. However, the perception of *lack of time* was identified as the main barrier that needed to be surmounted. Though much of the data remain subtle, clear identifiable differences continue to be discernible between Pre-92 and Post-92 universities.

Kimmerle, J., Moskaliuk, J., & Cress, U. (2011). Using wikis for learning and knowledge building: Results of an experimental study. Journal of Educational Technology & Society, 14(4), 138-148.

Abstract: Computer-supported learning and knowledge building play an increasing role in online collaboration. This paper outlines some theories concerning the interplay between individual processes of learning and collaborative processes of knowledge building. In particular, it describes the co-evolution model that attempts to examine processes of learning and knowledge building by working on wikis. We report an experimental study that aimed at testing some predictions of this model empirically. The results support the assumption that accommodative knowledge building and a development of conceptual knowledge takes place particularly when there is incongruity at a medium level between people's knowledge and the information contained in a digital artefact. In contrast, assimilative knowledge building and the development of factual knowledge depends largely on people's prior knowledge. Concluding, the consequences of these findings on educational uses of wikis are discussed.

Flores, Ò., Verdú, N., Giménez, P., Juárez, J., Mur, J. A., & Menduiña, C. (2011). Web 2.0 in university teaching: Collaborative learning through technology. Electronic Journal of Research in Educational Psychology, 9(2), 931-960.

Abstract: The concept of web 2.0 refers to a set of applications that are always evolving according to the requirements that users of these applications have. A lot of virtual 2.0 tools can be found in the internet: blogs, wikis, shared markers, shared files, forums, and so on. Teaching and learning processes should take into account all tools and resources that ICT offer, so that students and teachers have a great range of educational possibilities. Focusing on university education, we can find several investigations about the computer supported collaborative knowledge. The research that we are going to explain is an analysis of several Web 2.0 tools and their potential use in the teaching-learning process. Furthermore, we have collected a set of teaching and learning university experiences about the development of collaborative methodologies using ICT. We also offer recommendations for use of these tools in teaching and learning processes.

Chao, Y. J., & Lo, H. (2011). Students' perceptions of wiki-based collaborative writing for learners of english as a foreign language. Interactive Learning Environments, 19(4), 395-411. doi: http://dx.doi.org/10.1080/10494820903298662

Abstract: This study proposes a Wiki-based collaborative writing approach to the writing process for EFL (English as a foreign language) learners. A five-stage computer-mediated collaborative writing project including collaborative planning, partitioned drafting, peer-revising, peer-editing, and individual publishing was blended with on-campus English composition course. Fifty-one L2 learners at a university in central Taiwan participated in this project. Procedural scaffolding and collective scaffolding were provided to promote students' self-regulation and thus to foster the development of students' writing skills. A cross-referencing questionnaire survey was adopted to investigate students'

perceptions of Wiki-based collaborative writing and students' perceptions of their work in each stage of collaborative writing. As the results indicated, a high percentage of students' satisfaction showed positive perceptions of this Wiki-based collaborative writing environment, and the instructional design of implementing a Wiki-based collaborative writing project with a five-stage writing process does assist EFL learners to accomplish a collaborative writing task on the internet with less limitation of time. This article also points to new possibilities for future research.

Naismith, L., Lee, B. -., & Pilkington, R. M. (2011). Collaborative learning with a wiki: Differences in perceived usefulness in two contexts of use. Journal of Computer Assisted Learning, 27(3), 228-242. doi: http://dx.doi.org/10.1111/j.1365-2729.2010.00393.x

Abstract: This paper investigates the potential of a wiki (FlexWiki) to support collaborative authoring of web resources in authentic coursework by two different sets of education students at different stages of their professional development. Research questions included: (1) how the selected wiki could be blended with curriculum activities and existing technologies to complete collaborative tasks; (2) student and tutor expectations concerning collaborative learning and whether these expectations were met; (3) the barriers and enablers of using the wiki and perceptions of the task-technology fit. Key findings included that tutors and students were able to use the wiki to complete tasks; tutors and students were positive about learning outcomes but collaboration was not as co-constructive as hoped for; there were tensions between expectations of collaboration and assessment practices that affected how students collaborated; differences between participants in their group interaction, degree of co-presence and familiarity with technology led to differences in perceptions of usefulness and actual wiki use; and version-tracking data from the wiki proved unreliable on its own for gaining insights into actual collaborative processes. These findings suggest the importance of considering detailed local contexts of use when deciding to adopt new tools for supporting collaboration.

Glassman, M., & Kang, M. J. (2011). The logic of wikis: The possibilities of the web 2.0 classroom. International Journal of Computer-Supported Collaborative Learning, 6(1), 93-112. doi: http://dx.doi.org/10.1007/s11412-011-9107-y

Abstract: The emergence of Web 2.0 and some of its ascendant tools such as blogs and wikis have the potential to dramatically change education, both in how we conceptualize and operationalize processes and strategies. We argue in this paper that it is a change that has been over a century in coming. The promise of the Web 2.0 is similar to ideas proposed by Pragmatists such as Charles Peirce and John Dewey. Peirce proposed the logic of abduction as critical for the types of unique/progressive thinking that leads to creative problem solving and/or discovery. While logic based in deduction offers outcomes with certainty, logic based in abduction offers potentially valuable insights. Dewey tried to implement progressive education in the classrooms. Dewey's ideas, while influential, were often misunderstood, or considered too idealistic and/or unworkable in the traditional classrooms. Logics based in abduction required that different major premises and

hypotheses for problem solving be held simultaneously and over time. This type of scenario is often times difficult if not impossible in education based on direct interactions. Hypertext, especially as capture through emerging tools of Web 2.0, may offer the technologies that enable the type of information based networks within the education process that promote abduction and the democratic classroom as Dewey envisioned.

Witney, D., & Smallbone, T. (2011). Wiki work: Can using wikis enhance student collaboration for group assignment tasks? Innovations in Education and Teaching International, 48(1), 101-110. doi: http://dx.doi.org/10.1080/14703297.2010.543765

Abstract: Dissatisfaction with the quality of student group work, in terms of content and process, from both academics and students, is a constant challenge to the development of appropriate teaching, learning and assessment strategies. Developments in Web 2.0 technology could potentially offer a solution. This paper explores the experience of full-time undergraduate students using a wiki to support group assessments. The results suggest that student preference for traditional face-to-face co-operative working is a key limiting factor to the effective introduction of on-line tools. The paper questions whether wikis can enhance the experience of collaborative working in the absence of strategies for developing students' collaboration skills and without addressing their motivation to use wikis.

Cho, Y. H., Lee, J., & Jonassen, D. H. (2011). The role of tasks and epistemological beliefs in online peer questioning. Computers & Education, 56(1), 112-126.

Abstract: The current study examines the assertion that students are motivated and learn more by carrying out tasks consistent with their epistemological beliefs in web-based learning environments. In the study, 120 undergraduate students in an educational technology course participated as part of their coursework. Using a wiki, triads reciprocally asked and responded to questions as constructing either a group summary or a group argument. Students with less advanced epistemological beliefs more actively coordinated formats and procedures for group work and achieved higher comprehension of reading materials in the collaborative summary than in the collaborative argumentation. By contrast, these differences were not found for students with more advanced epistemological beliefs. However, the interaction effect between tasks and epistemological beliefs disappeared for the quality of argumentation on case problems. Independently of epistemological beliefs, collaborative argumentation promoted more constructive and interactive peer questioning activities and helped to construct higher quality arguments in case problems than collaborative summary. Therefore, the effects of matching tasks and epistemological beliefs varied depending on types of learning outcomes (comprehension vs. argumentation) in online peer questioning.

Sanden, S., & Darragh, J. (2011). Wiki use in the 21st-century literacy classroom: A framework for evaluation. Contemporary Issues in Technology & Teacher Education, 11(1), 6-20.

Abstract: In today's Web 2.0 world, teachers are perpetually struggling with how to incorporate technology into the classroom effectively in order to meet the diverse literacy needs of 21st-century learners. Utilizing the National Council of Teachers of English (NCTE, 2008) Position Statement addressing these needs, the theoretical framework of Lankshear and Knobel (2006), and work by Cummins, Brown, and Sayers (2007) emphasizing the possibilities of technology in achieving literacy goals, a framework by which to assess the incorporation of technologies in classrooms as a means to build students' new literacies was created. Finally, as a specific example, the framework was applied to the use of wikis to illustrate the literacy learning potential of both wikis and other new technologies.

Soon, L. (2011). E-learning and m-learning: Challenges and barriers in distance education group assignment collaboration. International Journal of Mobile and Blended Learning, 3(3), 43-58. doi: http://dx.doi.org/10.4018/jmbl.2011070104

Abstract: This research explores the relationship between e-learning and m-learning by investigating distance education students' use of a learning management system, "Interact," for virtual team work. The paper explores their experience of online collaborative group assignments in the subject "Information Management in Organisations." International and local students were grouped. Each group undertook a case study project to propose solutions for identified problems in their chosen organisations. Students developed their assignment in wikis and used various tools for communication and document storage. An anonymous web-based survey was conducted after students completed the group assessment. The results reflected a wide range of factors including technology use, working with students from a different country, and challenges they faced completing group assessment online. Their feedback on their e-learning experience indicated the need for m-learning to address their concerns. The findings indicate a need for m-learning to support e-learning further, which could significantly improve the facilitation of online collaborative group assignments.

Armellini, A., & Aiyegbayo, O. (2010). Learning design and assessment with e-tivities. British Journal of Educational Technology, 41(6), 922-935.
doi: http://dx.doi.org/10.1111/j.1467-8535.2009.01013.x

Abstract: This paper reported on the findings of research into innovation in e-learning design and assessment through the development and implementation of online learning activities (e-tivities). The focus of the study was on Carpe Diem as a process to enable academic course teams to seize 2 days to design and embed pedagogically appropriate e-tivities into their courses. The study also addressed the use of technology in the design of e-tivities and the level of tutor and learner engagement with them during course delivery. Six academic course teams representing three disciplines at four British universities took part in this 12-month study. Cognitive mapping was the main research methodology used. The results suggested that Carpe Diem is an effective and powerful team-based process to foster pedagogical change and innovation in learning design and assessment practices. The e-tivities designed during Carpe Diem were successfully used primarily for learning and formative assessment, and exceptionally for summative assessment. Web 2.0 tools, especially wikis, were employed to

enable collaborative online learning and were prominent in the new designs. The tutors' e-moderation skills were key to engage learners and thus capitalise on the benefits of e-tivities.

Su, F., & Beaumont, C. (2010). Evaluating the use of a wiki for collaborative learning. Innovations in Education and Teaching International, 47(4), 417-431. doi: http://dx.doi.org/10.1080/14703297.2010.518428

Abstract: A wiki is able to provide a learning environment which is closely aligned with the social-constructivist approach and is more natural than many tools where open collaboration and the exchange of ideas are important. This case study analyses and evaluates essential aspects for the successful deployment of a wiki in a higher education setting using Salmon's five-stage e-learning framework. Indicators of the learning benefits were determined by qualitative analysis of students' wiki contributions. Students' perceptions were captured through interviews and questionnaires at the start and end of the project, thereby providing indicators of their motivation towards this method of learning. Our results suggest that a wiki can promote effective collaborative learning and confidence in formative self and peer assessment by facilitating rapid feedback, vicarious learning through observing others' contributions and easy navigation and tracking facilities. Student authorship was also encouraged. Issues identified included providing easy access to the wiki, lack of personalisation, possible vandalism and plagiarism. Also, students with learning difficulties might require extra help and take longer to familiarise themselves with this new e-learning environment.

Varga-Atkins, T., Dangerfield, P., & Brigden, D. (2010). Developing professionalism through the use of wikis: A study with first-year undergraduate medical students. Medical Teacher, 32(10), 824-829. doi: http://dx.doi.org/10.3109/01421591003686245

Abstract: Aim: Learning about professionalism occurs through collaboration, with peer groups being important sources of support for students [Sandars J, Homer M, Pell G, Croker T. 2008. Web 2.0 and social software: The medical student way of e-learning. Med Teach 14:1–5. Accessed 2008 February 14]. This study aimed to discover whether the use of wikis (collaborative websites) could enhance medical students' development of professionalism. Methods: An online wiki was made available to four problem-based learning (PBL) groups, involving 32 students. Data collection comprised a small-scale student survey and four focus groups eliciting their views about wiki use, triangulated with facilitator interviews and wiki usage statistics. Results: Several factors affected individual student and group engagement with wikis, such as positive group dynamics. Students shared web links, helping clarify PBL discussions and increase their confidence. Conclusions: Two main benefits of using wikis for the development of professionalism with medical students were revealed. First, wikis acted as a shared knowledge base for hard-to-find resources on professionalism. Second, it was precisely when students reflected on the difference between interacting in wikis and their online social spaces, or when they considered whether or not to post a resource that their sense of professionalism emerged.

Karasavvidis, I. (2010). Wiki uses in higher education: Exploring barriers to successful implementation. Interactive Learning Environments, 18(3), 219-231. doi: http://dx.doi.org/10.1080/10494820.2010.500514
Abstract: E-learning 2.0 is expected to address some of the problems which characterized the first generation of E-learning implementations. Wikis are among the most promising E-learning 2.0 tools because they require active student engagement which facilitates constructivist learning. The present article focuses on the use of wikis in a university education and examines the student perspectives related to this use. Thirty-eight students participated in a study which aimed to examine students' difficulties with a wiki implementation in an undergraduate course. By drawing on qualitative data, seven major types of problems that the students experienced with the wiki task were identified. It is argued that the reason why the students lacked the knowledge and skills to deal with the wiki assignment is because they were accustomed to traditional practices. The article is concluded with a discussion of how traditional practices and the associated learning epistemologies are incompatible with the wiki requirements which are more constructivist in nature.

Huang, W. D., & Nakazawa, K. (2010). An empirical analysis on how learners interact in wiki in a graduate level online course. Interactive Learning Environments, 18(3), 233-244. doi: http://dx.doi.org/10.1080/10494820.2010.500520
Abstract: As Web 2.0 emerging technologies are gaining momentum in higher education, educators as well as students are finding new ways to integrate them for teaching and learning. Technologies such as blogs, wikis and multimedia-sharing utilities have been used to teach various subject matters. This trend not only creates new opportunities for us to afford collaborative learning processes but also generates research inquiries that demand that we empirically examine those technologies' pedagogical impact against existing theoretical frameworks. By doing so, we are able to validate Web 2.0 technologies' systematic integration into instructional settings while innovating the learning process for new generations of learners. Therefore, this exploratory mixed-method case study, situated in a 10-week online graduate level course, investigated the perceived interaction levels between learner-learner and learner-instructor in using PBwiki for weekly reading assignments. Based on quantitative responses from 16 participants, learners perceived a significantly higher level of instructional interaction with their peers than they did with the instructor. Their qualitative responses further identified their weekly activity patterns in accomplishing the Wiki assignments and provided rationales for their interaction level perceptions. This case study concluded that educators should remove all communication modalities external to the Wiki environments to provide authentic Wiki-collaboration experiences for learners.

Hulbert-Williams, N. (2010). Facilitating collaborative learning using online wikis: Evaluation of their application within postgraduate psychology teaching. Psychology Learning & Teaching, 9(1), 45-51. doi: http://dx.doi.org/10.2304/plat.2010.9.1.45

Abstract: Virtual learning environments (VLEs) are helpful in achieving a blended learning approach to higher education. Online wikis are proposed as a potentially useful method to encourage collaborative learning through the VLE. The present study integrated wiki software into a module for Masters-level applied psychology students. Seventeen students participated in a week-long online group-based wiki task as a standard part of their course. The use of wiki technology to develop an innovative research idea was evaluated both by analysis of output (tracking of engagement with the intervention) and by self-report questionnaire (evaluation of the intervention) collected from a subsample of 14 students. Results indicate that the students enjoyed the task and perceived educational benefit from it. However, the content of the wikis created suggests that the instructions given to the students may not have been clear enough, and in particular that students were unsure of what the nature and purpose of a wiki is. Students clearly needed more preparatory training in using this technology, and clearer explanation of expected outputs, before beginning this task. This study provides further evidence that students benefit from, and enjoy, blended learning approaches and that wikis represent a useful way to integrate blended and collaborative learning principles.

Bradley, L., Lindström, B., & Rystedt, H. (2010). Rationalities of collaboration for language learning in a wiki. ReCALL: Journal of Eurocall, 22(2), 247-265.
doi: http://dx.doi.org/10.1017/S0958344010000108
Abstract: For language learning, online environments allowing for user generated content are becoming increasingly important since they offer possibilities for learners to elaborate on assignments and projects. This study investigates what wikis can do as a means to enhance group interaction, when students are encouraged to participate in constructing text and exchanging peer response. The research focus is on exploring what interaction unfolds in the wiki and how it promotes language learning, from a sociocultural perspective. This interaction is framed both by affordances in the wiki but also by what is expected from students as language learners in an English for Specific Purposes class environment. The analysis has a multilevel approach, focusing on patterns of interaction and the nature of feedback. The study shows that collaboration becomes specifically interesting from a language learning perspective. In the findings, on the student wiki pages there are numerous contributions relating to both local language and global content. Revising co-constructed text opens up possibilities for the students to evaluate existing contributions and it also provides opportunities for them to suggest constructive changes. In addition, with the environment being web based, we discuss certain benefits arising from the fact that it allows for user-generated content.

Walsh, L. (2010). Constructive interference: Wikis and service learning in the technical communication classroom. Technical Communication Quarterly, 19(2), 184-211.
doi: http://dx.doi.org/10.1080/10572250903559381
Abstract: Four service-learning projects were conducted in technical communication courses using wikis. Results confirm previous findings that wikis improve collaboration, help develop student expertise, and enact a "writing with the community" service-learning paradigm. However, wikis did

not decenter the writing classroom as predicted by previous work. Instructors using wikis to scaffold client projects should calibrate standards for evaluation with students and client, and they may need to encourage clients to stay active on the wiki.

Kessler, G., & Bikowski, D. (2010). Developing collaborative autonomous learning abilities in computer mediated language learning: Attention to meaning among students in wiki space. Computer Assisted Language Learning, 23(1), 41-58.
doi: http://dx.doi.org/10.1080/09588220903467335
Abstract: This study reports on attention to meaning among 40 NNS pre-service EFL teachers as they collaboratively constructed a wiki in a 16-week online course. Focus is placed upon the nature of individual and group behavior when attending to meaning in a long-term wiki-based collaborative activity as well as the students' collaborative autonomous language learning abilities. Phases of group collaboration as well as individual language acts were analyzed. Student interaction and language use appear to benefit from flexible learning environments although student use of these spaces may not be consistent with instructor expectations. More important than the quality of the final wiki is the process students engage in as they write collaboratively. The paper concludes with a proposed framework for CALL research and practice.

Meishar-Tal, H., & Gorsky, P. (2010). Wikis: What students do and do not do when writing collaboratively. Open Learning: The Journal of Open and Distance Learning, 25(1), 25-35.
doi: http://dx.doi.org/10.1080/02680510903482074
Abstract: We investigated the collaborative writing actions carried out by 60 Open University of Israel graduate students as they built a wiki glossary of key course concepts. These actions were analysed using a taxonomy of collaborative writing actions (i.e. adding, editing and deleting information) in order to find out what students do and what they do not do when writing collaboratively. Two main findings were reported: in accord with previous research, students most frequently add content to a wiki rather than delete existing text; and contrary to previous research, students modify existing texts to a greater extent than previously reported. These findings may help teachers design collaborative learning activities. Teachers should be aware of the difficulties faced by students when writing collaboratively and should design collaborative learning activities in ways that overcome or circumvent these difficulties.

Chang, Y., Morales-Arroyo, M., Than, H., Tun, Z., & Wang, Z. (2010). Collaborative learning in wikis. Education for Information, 28(2-4), 291-303.
Abstract: Wikis are a supporting tool for pupils' learning and collaboration. Tasks such as cooperative authoring, joined workbooks creation, document review, group assignments, reflection notes and others have been tried out using wikis as a facilitating tool [1]. However, few studies have reported how students actually perceive some well-claimed benefits. This study investigated the perception of learning activities facilitated by wikis, and the effectiveness of several roles wikis might

play in constructive and collaborative learning. This study tried to answer the following questions. How do students perceive a wiki as a learning tool? How does a wiki support constructive learning skills? How does a wiki support student's collaborative learning skills? How does collaboration in wiki facilitate students' content learning and project work? The study was conducted using a survey method to examine the perception of wiki usage and collaborative and constructive learning. In the reported study, a questionnaire was used to gather data from 92 graduate students. The results suggest that using wikis were perceived to enhance collaborative knowledge building among students, but it did not contribute much to learning the subject matter although students were more involved in the learning process than with conventional teaching methods. In other words, it indicates that students may not obtain better return of investment on the time spent in using wiki as a learning tool. While wiki did contribute to enrich the learning experience, further study is needed to investigate how to link the learning process with learning outcomes using this type of collaboration tools.

Hazari, S., & Penland, T. (2010). Framework for developing and assessing business education wikis. International Journal of Web-Based Learning and Teaching Technologies, 5(3), 1-13. doi: http://dx.doi.org/10.4018/jwltt.2010070101

Abstract: The use of Web 2.0 tools is becoming widespread in business education and educators are increasingly exploring the use of Blogs, Wikis, and Podcasts in their courses. For teaching and learning to be effective in new technology-based environments, there is a need to research and design Web 2.0 learning systems that are effective platforms for incorporating interactive tools to engage students in learning. Although Web 2.0 assignments are usually tailored to meet specific learning objectives of courses and instructions can be made available to students to address the technical nature of the environment, development and assessment of Web 2.0 assignments remains a challenge for most business educators. Using the context of wikis, this article proposes a framework for development and assessment of business education wikis to assist educators who want to explore the use of wikis in their courses.

Daele, A. (2010). Reifying, participating and learning: Analysis of uses of reification tools by a community of practice. International Journal of Web-Based Learning and Teaching Technologies, 5(1), 43-60. doi: http://dx.doi.org/10.4018/jwltt.2010010104

Abstract: This paper presents observations and analysis of an activity of reification of professional practices within a community of practice. A case is examined of a distance community of tutors using a semantic Wiki for formalising their practices and a tool for storing and classifying documents. On the basis of the instrumental genesis theory, the author highlights the process of appropriation of the tools by the community of practice. This community participated in the development and conception of uses for the tools through a research and development project based on participatory design. This appropriation process, even if it did not occur to the expected extent, did nonetheless allow the community's members to develop their representations regarding the reification of their practices and, gradually, to elaborate broader uses of the tools.

Moskaliuk, J., Kimmerle, J., & Cress, U. (2009). Wiki-supported learning and knowledge building: Effects of incongruity between knowledge and information. Journal of Computer Assisted Learning, 25(6), 549-561. doi: http://dx.doi.org/10.1111/j.1365-2729.2009.00331.x

Abstract: This study describes the empirical test of a theoretical model of knowledge building with wikis that was recently introduced by Cress and Kimmerle. The underlying assumption of this model is that both learning (as an internal, individual process) and knowledge building (as the creation of public knowledge) are based on the interplay between an individual's knowledge and the information available in the wiki. Incongruity between individual knowledge and the information contained in the wiki will lead to learning (through the acquisition of factual and conceptual knowledge) and to knowledge building (through assimilation and accommodation). In three conditions, the experiment provided the participants with different levels of incongruity between their individual knowledge and information in the wiki by varying the amount of information that was contained in the wiki, while the amount of information that the participants possessed was kept constant. As predicted, the results confirmed that a medium level of incongruity between an individual's knowledge and the information that a wiki contains will best support learning. Moreover, a medium level of incongruity leads to more accommodative knowledge building despite the fact that high and medium levels of incongruity will result in similar amounts of assimilative knowledge building.

Cronin, J. J. (2009). Upgrading to web 2.0: An experiential project to build a marketing wiki. Journal of Marketing Education, 31(1), 66-75. doi: http://dx.doi.org/10.1177/0273475308329250

Abstract: Wikis are one of the newest features of Web 2.0. This article describes the implementation of a project in a marketing course in which students created an interactive textbook using wiki software. Several surprises encountered along the way are described, and the unique problem of grading individual contributions to a wiki is discussed. The author concludes that the wiki work improved the collaboration skills of students, but effects on learning could not be assessed. Strategies are provided that other instructors interested in using a wiki in the classroom can use to make the experience fulfilling for both instructor and students. The article ends with a call for the development of better grading methods and for assessment of the impact of wikis on learning.

Benckendorff, P. (2009). Evaluating wikis as an assessment tool for developing collaboration and knowledge management skills. Journal of Hospitality and Tourism Management, 16(1) doi: http://dx.doi.org/10.1375/jhtm.16.1.102

Abstract: In the knowledge-based digital economy the ability to harness digital technologies to capture and manage information is a critical skill for tourism professionals. This article examines the use of wikis as a teaching and learning tool to help students develop a range of knowledge management skills, including creative collaboration, consensus-building and technical literacy. The purpose of the study is to provide an exploratory analysis of student attitudes toward the use of wikis

as a collaborative assessment task. The results indicate that wikis are perceived to be a flexible, convenient and fair pedagogical technique for collaborative learning. Many students readily understood and exploited the collaborative and reflective nature of wikis. However, some students did not spend enough time on the task and did not appear to gain as much from the learning experience. This impacted on the extent and quality of collaboration in some groups. It is suggested that a staged wiki assessment might overcome some of the perceived shortcomings reported by students.

Cole, M. (2009). Using wiki technology to support student engagement: Lessons from the trenches. Computers & Education, 52(1), 141-146.
doi: http://dx.doi.org/10.1016/j.compedu.2008.07.003
Abstract: This paper reports on a failed experiment to use Wiki technology to support student engagement with the subject matter of a third year undergraduate module. Using qualitative data, the findings reveal that in an educational context, social technologies such as Wiki's, are perceived differently compared with ordinary personal use and this discourages student adoption. A series of insights are then offered which help HE teachers understand the pitfalls of integrating social technologies in educational contexts.

Minocha, S. (2009). Role of social software tools in education: A literature review. Education & Training, 51(5-6), 353-369. doi: http://dx.doi.org/10.1108/00400910910987174
Abstract: Purpose: The purpose of this paper is to provide a review of literature on the role of Web 2.0 or social software tools in education. Design/methodology/approach: This paper is a critical and comprehensive review of a range of literature sources (until January 2009) addressing the various issues related to the educator's perspective of pedagogical effectiveness of social software tools. Findings: The paper provides insights about the: educational goals of using social software tools; benefits to the students, educators and institutions; challenges that may influence a social software initiative; and issues that need to be considered in a social software initiative. Research limitations/implications: It is hoped that the analysis, as captured in this paper, will highlight the different pedagogical roles of social software: communication, nurturing creativity and innovation, and collaborative learning. The paper will be of interest to researchers in the areas of social software and technology-enabled learning environments, in general. Further, this paper demonstrates how the analysis of academic literature sources has been combined with commentaries and opinions on the web to develop this literature review. Practical implications: The review has been written from an educator's perspective: the questions and challenges that an educator encounters when considering the use of social software tools for learning and teaching. The analysis of the literature review in this paper is presented as answers to questions, which educators may have about social software initiatives. The findings in this paper may influence learning and teaching strategies in higher and further education—specifically institutions that are considering the use of social software. Originality/value: The paper presents theoretical underpinnings related to pedagogical role of social

software tools. In this paper, the practical issues and challenges for educators and policy makers who are considering the adoption of social software tools in learning and teaching are analysed. The paper consolidates a variety of literature sources from academic publications, recent reports on social software (2007-2009), and commentaries and views on social software within the social media itself (blogs, wikis, YouTube).

Minocha, S. (2009). An empirically-grounded study on the effective use of social software in education. Education & Training, 51(5-6), 381-394.
doi: http://dx.doi.org/10.1108/00400910910987192
Abstract: Purpose: The purpose of this paper is to discuss the results of an empirical investigation of the effective use of social software in further and higher education. The aims of the research are to: identify situations where social software tools had been employed in learning and teaching; elicit the experiences of the staff and students; and to draw out the benefits, challenges and issues (and their resolutions) associated with the use of social software. Design/methodology/approach: In the empirical study, data from 26 initiatives, where social software tools have been employed, were collected, analysed and synthesised. A case study methodology was followed and both educators and students were interviewed to find out what they had done, how well it had worked, and what they had learned from the experiences. Findings: This study provides insights about the benefits to the students, educators and institutions; challenges that may influence a social software initiative; and issues that need to be considered in a social software initiative. Research limitations/implications: The data analysis in this project has been qualitative. In future research, it would be useful to obtain quantitative evidence relating to the effectiveness of the use of social software. Such evidence would be of considerable assistance to institutional policy makers. The case studies in the project are snapshots of the current situation. It would be useful to carry out longitudinal studies over a period of time to investigate the sustainability of the individual initiatives. Practical implications: It is hoped that the lessons captured in this paper will inform the learning and teaching strategies in higher and further education—specifically, assisting the institutions and educators who are considering the use of social software, or more generally, people or organisations undertaking technology-enabled learning and teaching initiatives. Originality/value: The published research so far has tended to focus on the use of forums, blogs and wikis, rather than extending to encompass other social software. Furthermore, the literature discusses experiences of individual educators and with a small set of students. The project reported in this paper examined data from 26 initiatives from a varierty of institutions, involving a wide range of social software tools, and in diverse contexts.

Wheeler, S., Yeomans, P., & Wheeler, D. (2008). The good, the bad and the wiki: Evaluating student-generated content for collaborative learning. British Journal of Educational Technology, 39(6), 987-995. doi: http://dx.doi.org/10.1111/j.1467-8535.2007.00799.x
Abstract: This paper explores the potential for wiki-type open architecture software to promote and support collaborative learning through the use of student-created content. It delineates some of the

affordances and constraints of wiki software as an open architecture that has the potential to facilitate collaborative learning through community-focused enquiry. It seeks to promote debate in this key area of development, and highlights some recent key contributions to the developing discourse on social software in what has been termed 'the architecture of participation'.

Shih, W., Tseng, S., & Yang, C. (2008). Wiki-based rapid prototyping for teaching-material design in e-learning grids. Computers & Education, 51(3), 1037-1057. doi: http://dx.doi.org/10.1016/j.compedu.2007.10.007

Abstract: Grid computing environments with abundant resources can support innovative e-Learning applications, and are promising platforms for e-Learning. To support individualized and adaptive learning, teachers are encouraged to develop various teaching materials according to different requirements. However, traditional methodologies for designing teaching materials are time-consuming. To speed up the development process of teaching materials, our idea is to use a rapid prototyping approach which is based on automatic draft generation and Wiki-based revision. This paper presents the approach named WARP (Wiki-based Authoring by Rapid Prototyping), which is composed of five phases: (1) requirement verification, (2) query expansion, (3) teaching-material retrieval, (4) draft generation and (5) Wiki-based revision. A prototype system was implemented in grid environments. The evaluation was conducted using a two-group t-test design. Experimental results indicate that teaching materials can be rapidly generated with the proposed approach.

Hsu, J. (2008). Innovative technologies for education and learning: Education and knowledge-oriented applications of blogs, wikis, podcasts, and more. International Journal of Web-Based Learning and Teaching Technologies, 3(3), 62-81. doi: http://dx.doi.org/10.4018/jwltt.2008070106

Abstract: A number of new communications technologies have emerged in recent years that have been largely regarded and intended for personal and recreational use. However, these "conversational technologies" and "constructivist learning tools," coupled with the power and reach of the Internet, have made them viable choices for both educational learning and knowledge-oriented applications. The technologies given attention in this article include instant messaging (IM), Weblogs (blogs), wikis, and podcasts. A discussion of the technologies and uses, underlying educational and cognitive psychology theories, and also applications for education and the management of knowledge, are examined in detail. The implications for education, as well as areas for future research are also explored.

Minocha, S., & Roberts, D. (2008). Social, usability, and pedagogical factors influencing students' learning experiences with wikis and blogs. Pragmatics & Cognition, 16(2), 272-306. doi: http://dx.doi.org/10.1075/p&c.16.2.05min

Abstract: With a variety of technology-enabled tools and environments to choose from, it is increasingly difficult for educators to ascertain the factors that influence the quality of the students'

learning experience and hence make appropriate choices for the use of technology. In this paper, we discuss the role of two technologies--wikis and blogs--in teaching and learning. We provide case studies of two courses at the Open Umiversity, UK and empirical evidence of students' experiences, perceptions, and expectations on these courses. We discuss the context of these courses and the usage of these technologies: The pedagogical underpinnings and the rationale for introducing these technologies; the intended learning outcomes from the usage of these tools; and the extent to which the activities based around these tools have enabled the intended learning and facilitated the learning process. We report on the social, usability, and pedagogical factors that have influenced the quality of students' learning experience. The research reported in this paper aims to provide guidance to course designers and educators for choosing tools, particularly wikis and blogs, for their contexts and for creating value and generating a positive student experience to engender student satisfaction and retention.

Hsu, J. (2007). Innovative technologies for education and learning: Education and knowledge-oriented applications of blogs, wikis, podcasts, and more. International Journal of Information and Communication Technology Education, 3(3), 70-89. doi: http://dx.doi.org/10.4018/jicte.2007070107

Abstract: A number of new communications technologies have emerged in recent years that have been largely regarded and intended for personal and recreational use. However, these "conversational technologies" and "constructivist learning tools," coupled with the power and reach of the Internet, have made them viable choices for both educational learning and knowledge-oriented applications. The technologies given attention in this article include instant messaging (IM), Weblogs (blogs), wikis, and podcasts. A discussion of the technologies and uses, underlying educational and cognitive psychology theories, and also applications for education and the management of knowledge, are examined in detail. The implications for education, as well as areas for future research are also explored.

Bold, M. (2006). Use of wikis in graduate course work. Journal of Interactive Learning Research, 17(1), 5-14.

Abstract: Graduate education in an online environment frequently means relying on a course management system (CMS) but also calls for additional interactive components. Courses in an online Master's in Family Studies incorporated wikis (Hawaiian word for "quick") to support collaboration among students. Online collaboration can replicate the expected cooperative learning among graduate students in on-campus settings. To accomplish this, wiki technology was utilized for collaborative webpages.