Developments in Educational Psychology:

Multimedia Comprehension

**EPSY 490, Section JC (CRN 66109)**

## Wednesdays 3:00 – 5:30 p.m.

**Fall, 2016**

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Office hours: Th 3:00 pm – 5:00 pm in person or electronically via Skype or Google Hangouts (please email me so I know to log on). First come, first served (no appointments possible). Other times available by appointment.

#### Course Description (from Undergraduate Catalogue):

Foundational theories and practices of educational psychology, including learning and development.

**Course Outline**

This course is designed to introduce researchers, designers, and instructors to the comprehension process of multiple media designed for educational use. Multimedia presentations are ubiquitous in formal and informal education, including traditional textbooks—whether in paper or e-book format, Web-based hyperlinked materials, educational games, animations, simulations, and other new hybrids such as virtual reality haptics. They can include representations such as text, narration, diagrams, graphs, photographs, animation, sounds, and other representations.

We will consider questions such as:

* What strategies do learners use to make sense of multimedia learning materials?
* What are the challenges of comprehending each representation by itself and integrating across representations?
* How are the processes similar or different when the representations are provided (e.g., text + diagram) vs. learner-constructed (e.g., text + learner draws a sketch)
* How do features of the learner, the task, the stimulus, and the context affect the process?
* What kinds of data collection methods have been used to study these processes?
* What design principles can be derived from these research findings?

**Course objectives:**

At the end of this course, students will be able to:

* critically read published articles investigating multimedia comprehension and
* write a critique of a published article
* evaluate an available multimedia learning tool for how well it is based in principles of learning
* more effectively design or work with designers to create a multimedia learning environment

**Readings and text:**

The majority of your reading will be from a library-accessible e-text: Mayer, R. E. (Ed.). (2014). *Cambridge handbook of multimedia learning* (2nd Ed.). New York, NY: Cambridge University Press. ISBN: 978-1107610316. Per the library policy you may download chapters and print a single copy of each for your own use, but you may not share (e.g., email, flash drive), post (e.g., to email lists, via the Internet), or otherwise disseminate any of the e-book.

**Students with Disabilities:**

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES you may visit 1207 S. Oak St., Champaign, call 333-4603 (V/TDD), or e-mail a message to [disability@uiuc.edu](mailto:disability@uiuc.edu).

To insure that disability-related concerns are properly addressed from the beginning, students with disabilities who require assistance to participate in this class are asked to see the instructor as soon as possible.

**Academic Integrity:**

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: <http://education.illinois.edu/edpsy/about/academic-integrity>. Please note that you are responsible for reading this policy. Ignorance is not an excuse for any academic dishonesty. Plagiarism or fair use violations will be dealt with without exceptions. <http://education.illinois.edu/edpsy/academicintegrity>. All writing—including draft portions submitted throughout the semester—must be submitted through UIUC’s SafeAssign interface in Blackboard and will be checked for plagiarism..

The Illinois Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: <http://www.admin.uiuc.edu/policy/code/>

**Evaluation:**

Student grades will be earned by students’ achievement on the following assignments. Please see the weekly schedule for due dates:

Weekly writing assignments (13 x 4% each) 52%

Individual class participation (individual forms, discussions,

and questions for visitors) 8%

Weekly article critiques (6 x 2% ea.) 12%

Final project written submission 20%

Final project oral presentation 8%

TOTAL 100%

*No Extra Credit:*

Your course grades are based only on the above information. There will be no extra-credit opportunities. Please do not ask for exceptions.

#### Assignments

**1) Thought questions, participation in discussion, and questions for visitors (15%).**

You will submit via email questions based on readings 1 day before class. I expect every member of the class to actively participate in discussions. You will also submit questions for guest speakers 1 day before the visit, when we have an in-person or virtual visitor. These questions can include questions about theory, methods, measures, data analysis, implications, an alternative explanation for a finding, something you are curious about—an idea for further research or something the speaker/author did not make clear in a paper, etc., etc. These questions should *not* be factual exam-type or end-of-chapter questions.

**2) Weekly individual writing assignments (12 x 4.17% each = 50%)**

The goal of these assignments is to help you, in small steps, learn how to draw implications for teaching and design from published articles. These assignments are explained in detail in Blackboard and must be submitted via Blackboard, where all writing will be screened using SafeAssign. Unless prior arrangements are made, no credit will be given for assignments submitted after class has begun. All weekly assignments may be revised once, with revisions due 1 week after receiving feedback (i.e., 2 class meetings after the initial submission).

**3) Weekly article critique assignments (6 x 2% each = 12%)**

The goal of these assignments is to help you learn to critique articles, noting both strengths and weaknesses across theory, methods, data analysis, and discussion. These assignments are explained in detail in Blackboard and must be submitted via Blackboard, where all writing will be screened using SafeAssign. Unless prior arrangements are made, no credit will be given for assignments submitted after class has begun. Article assignments may **not** be revised.

**4) Final project written submission (20%)**

The final project is a compilation *with additional revisions beyond weekly polishing* of the weekly writing assignments. See the syllabus for each weekly assignment with due dates; details for each assignment are given on Blackboard, where the assignment will submitted via SafeAssign software. The final project will be graded with a rubric posted to Blackboard with an example.

**5) Final project oral presentation**

In addition to the full written proposal, you will give an oral presentation of about 20 minutes, using a PowerPoint (or Prezi, etc.) file. Details for the assignment are given on Blackboard, where the assignment will submitted via SafeAssign software. The presentation will be graded with a rubric posted to Blackboard with an example.

If you have not used Blackboard before for your courses, helpful information will be found at [Link to UIUC Compass 2g for students](https://www.cites.illinois.edu/illinoiscompass/studentresources.html)

**Important Regulations**

Students are responsible for all information transmitted in the classroom. This includes material that may or may not be included in the readings, announcements about deadlines or changes of deadlines, meeting course requirements, etc.

Please notify me in advance if any assignment deadlines conflict with a religious observance.

Please notify me in advance if you will not be in class.

**Grades will be earned according to the following system**

97-100 = A+ 93-96.9 = A 90-92.9 = A-

87-89.9 = B+ 83-86.9 = B 80-82.9 = B-

77-79.9 = C+ 73-76.9 = C 70-72.9 = C-

67-69.9 = D+ 63-66.9 = D 60-62.9 = D-

#### Below 59.9 = F

**Weekly Schedule**

| Date/  Week | Topic | Readings (CHML = Cambridge Handbook) | Assignments due at the beginning of that class meeting |
| --- | --- | --- | --- |
| 8/24/2016  Week 1 | Introductions of us and the syllabus  Hints for locating articles  Definitions of multimedia and comprehension | None—first class | None—first class |
| 8/31/2016  Week 2 | Text and diagrams—empirical session #1 (basic research) | CHML Ch. 1 | Writing assignment 1—Explore 4 CBLEs  Article critique A |
| 9/7/2016  Week 3 | Text and diagrams—empirical session #2 (training studies) | CHML Ch. 11 | Writing assignment 2—Summarize 3 papers on one CBLE  Article critique B |
| 9/14/2016  Week 4 | Text and diagrams—theories | ***CHML Chs. 2, 3, 4, & 28*** | Writing Assignment 3— Explore 4 more CBLEs  Article critique C |
| 9/21/2016  Week 5 | Animation | CHML Ch. 22 | Writing assignment 4— Summarize 3 papers on one more CBLE  Article critique D |
| 9/28/2015  Week 6 | Internet/hyperlinked text | CHML Ch. 21 | Writing assignment 5—Description of focal CBLE  Article critique E |
| 10/5/2015  Week 7 | Coordinating mathematical representations/eye tracking | CHML Ch. 29 | ***Writing assignment 6—Theory behind focal CBLE*** |
| 10/12/2015  Week 8 | Simulations/learner control | CHML Ch. 30 | Writing assignment 7—Research methods  Article critique F |
| 10/19/2015  Week 9 | Haptics/virtual reality | 3 articles below | Writing assignment 8—Findings about focal CBLE |
| 10/26/2015  Week 10 | Student-constructed representations/sketching | CHML Ch. 18 | Writing assignment 9—Possibilities for this focal CBLE |
| 11/2/2015  Week 11 | The role of learner individual differences | CHML Ch. 24 | Writing assignment 10—Role of learner differences in focal CBLE |
| 11/9/2015  Week 12 | The role of stimulus characteristics/ design | CHML Ch. 8 | Writing assignment 11—Task features from this focal CBLE |
| 11/16/2015  Week 13 | The role of task characteristics  Review of final presentation written submission rubric and oral presentation rubric | CHML Ch. 13 | Writing assignment 12—Stimulus design choices from this focal CBLE |
| 11/23/2016 | Thanksgiving break – no class | Thanksgiving | Thanksgiving |
| 11/30/2015  Week 14 | The role of content features | 2 articles below | Writing assignment 13—Content design choices from this focal CBLE |
| 12/7/2015  Week 15 | Design principles/wrapup | ***CHML Ch. 12 & 14*** | ***Draft of final presentation written submission and PowerPoint*** |
| 12/14/2016  Week 16 | Final presentations and final paper due | None—final presentations and paper | Final oral presentation, PowerPoint, and written paper |

Note: Weeks with an extra-heavy workload are shown in ***bold Italics***

**Article readings for Week 9 Haptics**

Schonborn, K. J., Bivall, P., & Tibell, L. E. (2011). Exploring relationships between students' interaction and learning with a haptic virtual biomolecular model. *Computers & Education*, *57*(3), 2095-2105.

Zacharia, Z. C. (2015). Examining whether touch sensory feedback is necessary for science learning through experimentation: A literature review of two different lines of research across K-16. *Educational Research Review, 16*, 116–137. doi: 10.1016/j.edurev.2015.10.001

Millet, G., Lecuyer, A., Burkhardt, J.-M., Haliyo, S., & Regnier, S. (2013). Haptics and graphic analogies for the understanding of atomic force microscopy. *International Journal of Human-Computer Studies, 71*(5), 608-626. doi: 10.1016/j.ijhcs.2012.12.005

**Article readings for Week 14 Designed features of content**

Pollock, E., Chandler, P., & Sweller, J. (2002). Assimilating complex information. *Learning and Instruction, 12*, 61-86.

Lowe, R., Schnotz, W., & Rasch, T. (2011). Aligning Affordances of Graphics with Learning Task Requirements. *Applied Cognitive Psychology, 25,* 452–459.

**Written assignments**

**Assignment 1.** From my list (or alternatives I approve in advance), check out 4 computer-based multimedia learning environments. In some cases, there is (free) software to download. Spend some time getting to know each from your own perspective as a learner and/or teacher and/or designer. Write brief (1-paragraph per CBLE; 400-800 words) reflections on this exploration, being sure to give the specific source (including a URL). Consider including any of the following: a description, what you liked or disliked, how well you think students would learn from it, any interesting features.

CBLEs:

Crystal Island game <http://projects.intellimedia.ncsu.edu/crystalisland/getting-started/>

Medical text+diagrams information on the Internet such as <http://www.webmd.com/urinary-incontinence-oab/picture-of-the-kidneys>

NetLOGO <http://ccl.northwestern.edu/net>logo

Molecular Workbench <http://mw.concord.org>

PhET <http://phet.colorado.edu>

WISE <https://wise.berkeley.edu/>

Encyclopedia Brittanica <http://www.britannica.com/> (look for text + hyperlinks such as “Ear” and also for animations such as “Heart”)

Concord Consortium Energy 3D <https://concord.org/projects/engineering-energy#cc1>

Wikipedia <https://en.wikipedia.org/wiki/Main_Page> (look for text + hyperlinks such as “Elephant”)

College textbook auxiliary animations [http://www.macmillanlearning.com/catalog/studentresources/chemicalprinciples7e#](http://www.macmillanlearning.com/catalog/studentresources/chemicalprinciples7e)

Animations for learning found on YouTube such as <https://www.youtube.com/watch?v=pb1lRI-YePU>

Linked math representations at <http://www.mathopenref.com/graphfunctions.html>

Sketching with CogSketch <http://www.qrg.northwestern.edu/software/cogsketch/>

Virtual reality http://www.theverge.com/2016/4/28/11526150/crytek-the-climb-vr-oculus-rift-review

4 points: 1 for submission of 400-800, .25 for source description, 1.25 for liked/disliked, 1 for how it would help learning; .5 for formal, correct academic writing.

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**Assignment 2.** Of the 4 CBLE types you explored, choose one and find 3 research articles published about that type of CBLE (ideally all published on the **same** CBLE, but that may not be possible). Summarize briefly (1-paragraph per article) the articles. In the summary, report on who did what, when, where, and how? What was found?

4 points: 1 for submission summarizing 3 articles; 2.5 for who, what, when, where, and how; .5 for formal, correct academic writing.

Example: Bergey et al. (2015) had 9th and 10th grade biology students refresh content from their prior lessons using either diagram questions or text-based questions. Students completed exercises as in-class warmups. The diagram questions directed student attention to features such as captions, labels, numbering, color coding, and other conventions of diagrams. Students completed daily warmups over 4 weeks, and were given feedback on the correctness of their answers. Diagram warmup students improved significantly in biology diagram comprehension. Students can be taught how to learn better from text-with-diagrams, and this brief training had significant effects on comprehension.

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**Assignment 3.** Explore 4 more CBLEs, different from the ones above. Explore and write brief reflections as in Assignment 1.

4 points: 1 for submission of 400-800, .5 for source description, 1.5 for liked/disliked, 1 for how it would help learning.

**Assignment 4.** Of those 4 new CBLEs, choose one, find 3 research articles, and summarize as in Assignment 2.

4 points: 1 for submission summarizing 3 articles, 3 for who, what, when, where, and how.

**Assignment 5.** Choose your one favorite CBLE of the 8 you explored; this will be your focal CBLE for the rest of the assignments and your final presentation and paper. Write a thorough description of your focal CBLE. Be sure to name the developers, the subject matter covered, the features of the display, how a learner uses/interacts with the CBLE (even if there are no interaction features, say that), the task(s) the learner engages in, and any other details you think are important. Try to describe thoroughly enough that a person who did not have access to the CBLE itself could imagine it. Provide one visual with a caption (referencing the source unless you use a screen shot).

4 points: .5 each for developers, subject matter, features of display, learner interaction, the task(s); 1 for thoroughness; .5 for one visual with a caption & reference.

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**Assignment 6.** From the 3 articles you have already read, describe the theory of multimedia learning that underlies your focal CBLE. Use the chapters we have read in CHML and also the index to learn more about that theory. Write 1 paragraph of about 100-200 words describing the components of the theory (definitions will be needed) and also describing how the components work with each other according to the theory.

4 points: 1 for 100-200 words; 1 for Includes all parts of the theory; 1 for definitions, 1 for connects the parts accurately.

Example: The construction-integration theory (Kintsch, 1998) states that a reader forms a surface-level representation, a textbase and a situation model when reading. The surface-level model is a word-by-word record of what was read, which lasts very briefly. The textbase captures the gist or main ideas of what was read, but without incorporating prior knowledge. The situation model is a more complete (i.e., better) mental representation than the textbase, and is formed by the process of making inferences from information in the reader’s long-term memory that has been linked with what was read. In research, memory for what was read at the textbase level has been measured with word recognition tests, and memory for the situation model has been measured with inference verification tests. (Kintsch, 1998) predicts that poorer readers will have high textbase but low situation model scores, whereas better readers will have high textbase and high situation model scores, and this has been borne out in research with learners at different ages from middle school level through adults.

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**Assignment 7.** Across the 3 studies, describe the methods that were used to study learners: were there tests? Questionnaires? Computer records? Video recordings of learners interacting? Were student writings or attempts analyzed? Were experiments used, or just descriptions of learning? Use the class handouts to describe they type(s) of research used.

4 points: 1 for submission summarizing 3 articles; 2.5 for accurate descriptions of all of the research methods used; .5 for formal, correct academic writing.

Example: Bergey et al. (2015) in their experiment gave students brief warmup exercises consisting of either 1) diagram decoding tips plus questions requiring the use of diagrams or 2) textbook publisher-provided questions that do not refer to diagrams. Students were pre- and posttested on biology knowledge, geology knowledge, biology diagram comprehension, geology (transfer) diagram comprehension, and spatial skills. The specific student answers were scored and categorized (coded) for accuracy, for inferences, and for extent of student participation. Thus, data were collected about products of learning (e.g., knowledge posttests), processes of learning (e.g., inferences while learning), and extent of engagement (e.g., number of questions answered).

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**Assignment 8.** Considering all of the different outcomes (such as factual learning, mental models, transfer, motivation, engagement, etc.) from the 3 studies you have already read, summarize the effects of this CBLE. What effects can it have on learners? Where are there not effects? Are the effects consistent across the 3 studies? Are effects consistent across learners, or do some learners gain more?

4 points: 1 for submission summarizing 3 articles; 1 for accurate summary of all of the findings; 1.5 for accurately noting similarities and differences across the studies; .5 for formal, correct academic writing.

Example: Bergey et al. (2015) found that 9th grade biology students learned significantly from both the conventions-of-diagrams warmups and the publisher-provided warmups. The significant gains were found across all measures—biology knowledge, geology knowledge, biology diagram comprehension, and geology (transfer) diagram comprehension. The effect sizes for biology diagram comprehension for the conventions-of-diagram warmups was almost twice as large as for textbook warmups, suggesting this might be a better method for student diagram comprehension. There were no differences in the other 3 measures. The authors found that conventions-of-diagram warmups benefited high-knowledge and high-spatial students more, and disadvantaged low-knowledge and low-spatial students. [Note that further summaries would note similarities to and differences from this study in other conventions-of-diagrams intervention studies.]

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**Assignment 9.** All CBLEs have features that can help certain types of learning; we have called these affordances in class. Describe in 1-2 paragraphs the affordances of your focal CBLE—what kinds of learning does it seem that it might be particularly good for, and *why*? Describe the limitations—not criticisms of details of the design, but fundamental limitations (see example below).

4 points: 1 for submission of 100-200 words; 2.5 for accurate descriptions of affordances and limitations of the CBLE; .5 for formal, correct academic writing.

Example: Paper text with diagrams is ubiquitous in classroom textbooks. However, this form of multimedia is very demanding on learners, and there is ample evidence that learners struggle more with text+diagrams than with text by itself. On the one hand, cognitive processes in diagrams are more sophisticated (Cromley et al 2010; 2016); on the other hand, many learners simply skip diagrams. Likewise, diagrams can easily show spatial relations and steps in a process in a way that is very direct, but learners have to look for those spatial relations and follow the steps in the process. In addition, diagrams often have prominent/large elements that are not the most important parts of the process shown, and learners have to focus their attention on the critical steps in a process, not just the largest or brightest elements. Finally, learners need to use the information uniquely found in text and link this with information uniquely found in diagrams, which is a cognitively demanding task. Thus, learning from requires independent use of great skill by learners.

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**Assignment 10.** Based on the 3 articles, and also on your own experiences with your focal CBLE, how ***and why*** might learner individual differences play a role in learning this topic with these tasks and these stimuli? What prior knowledge, learning or organizational strategies, spatial skills, etc. does this CBLE demand? ***Why*** do you think these skills make this difference in this CBLE? There may not be strong research evidence, but use what you know to speculate about this.

4 points: 1 for submission summarizing 3 articles; 1.25 *how* individual differences matter; 1.25 for *why* individual differences matter; .5 for formal, correct academic writing.

Example: As noted above, with Bergey and colleagues’ (2015) conventions-of-diagram warmups the high-knowledge and high-spatial students benefited more, and low-knowledge and low-spatial students benefited less. With the textbook-based questions there were no effects of knowledge or spatial skills. The spatial effects make sense, because the biology diagrams show spatial relations such as a figure depicting parental, F1 and F2 generations of offspring (i.e., generational time mapped from top to bottom). Therefore, a low-spatial student in the conventions-of-diagrams condition might have trouble making this mapping and might have trouble learning from the diagram decoding tips. On the other hand, it is unclear why knowledge would not play the same role across these text-only and text-and-diagrams conditions.

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**Assignment 11.** Based on the 3 articles, and also on your own experiences with your focal CBLE, what do the assigned tasks demand? Describe the tasks in some detail, and break them down into parts. How might the task demands and individual differences you wrote about for Assignment 10 interact?

Rubric: ???

Example: ???

**Assignment 12.** Based on the 3 articles, and also on your own experiences with your focal CBLE, what are the designed features of the stimuli? Describe the designed features in some detail, and relate them to design principles in the literature. How might the designed aspects of the stimuli interact with the task demands and individual differences you wrote about for Assignments 10-11?

Rubric: ???

Example: ???

**Assignment 13.** Based on the 3 articles, and also on your own experiences with your focal CBLE, what are the designed features of the content? Describe the designed features in some detail. How might the designed aspects of the content interact with the designed features of stimuli, task demands, and individual differences you wrote about for Assignments 10-12?

Rubric: ???

Example: ???