

An Overview of Educational Multimedia Principles.

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Context

As we work to develop our representation and communication skills in our own practice, or as we invite our pre-service teachers to create learning resources (comics, videos, or activities) to assist their students in making sense of new ideas, or as we work with students in other areas who want to build multimedia creation knowledge and skills, we need to consider what principles might be recommended to support this creative process. Here we outline the principles of multimedia, design (or problem-solving), and storytelling. As we introduce them, we caution that although these principles are founded in theory, they aren't hard and fast laws—rather, they are tentative, evidence-based, 'rules' and 'best practices' that are evolving and overlapping, and that their application is dependent upon the context and the needs of the intended learners. This guide represents a small part of our ongoing efforts to reach out and support pre-service and in-service teachers as they climb over the thresholds of new technologies in their teaching practice (e.g., Pelton & Francis Pelton, 2008).

Interactive Multimedia design principles

Some multimedia principles will have the effect of reducing the effort the viewer needs to put into decoding, interpreting and capturing the presentation (i.e., essential processing), others are focused on avoiding noise and clutter that might waste cognitive potential (i.e., extraneous processing), while still others foster generative processing by encouraging engagement and effort that leads to understanding and transfer. The cognitive theory of interactive multimedia learning which formally describes these different types of processing and underlies many of the principles presented is not explicitly reviewed here, but the interested reader is encouraged to examine it (e.g., Meyer, 2014a & 2014b; Sorden, 2012). Some popular or nascent multimedia principles may focus on design and individual differences that seem reasonable but they tend to have a more modest or even a mixed collection of supporting evidence – that does not mean they have no value, rather that they should be applied carefully and reflectively. Finally, we note that some intuitively appealing principles may not be valid, and we need to continue to look for theory and evidence supporting their use before adopting or promoting them generally (e.g., Clark & Feldon, 2014).

In addition to well researched multimedia principles it is also important to consider problem-solving, design, interaction and storytelling principles. They guide the process of understanding, planning, designing and sharing the ideas or stories that we want to tell. These principles are useful too—although they may be less focused on theory and more founded on practical experience and reflection (informal/nascent theory). The reader is encouraged to review the literature in these directions (e.g., Brown 2009; Carroll, Goldman, Britos, Koh, Royalty & Hornstein, 2010; Lasica 2011; McKee 1997; Plattner, Meinel & Leifer, 2010; Polya, 1945; Rauth, Köppen, Jobst & Meinel, 2010)

A Guide for Creating Interactive Multimedia Learning Resources

The multimedia, design, and storytelling principles below are presented here with the intent to guide you through the creative process. The principles are not perfect or complete, and sometimes they may seem redundant or even contradictory, but each principle contains wisdom that is worth your consideration. It is suggested that you read through and consider the entire document before starting on your multimedia resource projects, then you might revisit this document and seek out some of the referenced material for additional inspiration as you work through the creation of your project/prototype. As you look back and reflect you might come back again and re-examine the principles to see how you might personalize them, or identify other principles that you would like to seek out and apply in the future. The four sections below address: telling a story that meets the learners' needs; minimizing cognitive distractions and maximizing efficiency; being more effective at designing, storytelling, and problem solving; and practical considerations to improve the quality of your projects.

Telling a story that meets the learner's needs

As you strive to settle on a story or idea that you wish to present you might consider the following principles to help you better meet the learners' needs:

P1. Keep it simple principle. Keep your story short and focused. What is your core message? You may have a surplus of dramatic and compelling ideas/information/shots—but don't use everything you have—just use what you need to make your story complete. You can always tell another story. (Lasica, 2010; Morra, 2013; Pappas 2014; Soloman 2014; Roup, 2016).

P2. Punchline principle. Storytelling is an act of engaging your audience in a problem solving process. You are providing enough interesting information to capture their attention and yet still challenging them to ask questions, seek answers, and predict what is coming next. "Storytelling is joke telling..." (Stanton, 2012)

P3. Engage principle. Keep looking until you find a story that moves you and your audience. "Storytelling isn't so much a process of arriving at a previously determined end, but about an investigation of the material." (K. Burns, in Soloman 2014). To maximize emotional relevance to the audience drop some of the boring informational parts and include the more emotionally/cognitively engaging parts (Roup, 2016).

P4. Characters principle. "...every story has characters—it's just a matter of letting them breathe and tell their stories." (K. Burns, in Soloman 2014). They need to be relevant and relatable to your audience (Pappas, 2014).

P5. Structure principle. The beginning sets up the story and intrigues the viewer, the middle provides needed information and the end is the destination or discovery of a solution that leads to insight. But don't always just tell it straight, a story should have an engaging plot structure to support and engage the audience in the journey (Pappas 2014). Lindsay suggests eight different structures that you might look at for a start: monomyth, mountain, nested, sparklines, start in the middle, converging ideas, false start, or petal (2014).

Minimizing cognitive distractions and maximizing efficiency

The following principles are founded in cognitive learning theory and multimedia research and they should be used as guides to help you minimize cognitive distractions, avoid overloading the learner, and maximize learning efficiency:

P6. Coherence principle. Eliminate extraneous material that requires extra effort to interpret, but contributes nothing to the core message. Don't change the stage/context without a purpose, don't include visual and audio that is not relevant/helpful, and don't bother putting the narrator on the screen (static or dynamic) if there is something more important to be seen. Seek to make elements of your message focused, consistent and harmonious (Mayer & Fiorella, 2014; Mayer, 2014b; Sorden, 2012).

P7. Signaling principle. Highlight essential material using labels and other visual cues so learners can understand and connect key elements and ideas (Mayer & Fiorella, 2014).

P8. Redundancy principle. (***)Note that this is very important!) Limit the visual text in your presentations—especially if it is also presented in your narration. Don't overload the learner by challenging them to interpret and reconcile redundant information presented through two channels (i.e., aural and visual; Pappas 2014; Mayer & Fiorella, 2014; Mayer 2014b).

P9. Multi-modality principle. (***)Note that this is very important!) Learners are better able to absorb information and ideas when some of the content (cognitive load) is redirected from the visual processing channel to the auditory processing channel (Mayer & Pilegard, 2014; Mayer 2014b). This means we should generally use voice to communicate textual information and avoid or limit the amount of text we present visually (i.e., generally limit it to signaling and concise lists).

P10. Pre-training principle. Help learners apprehend new ideas more efficiently by ensuring that they are given opportunities to learn key terms and characteristics of the main elements & concepts first (Mayer & Pilegard, 2014). When learners are presented with a lot of new information at once, they don't have time to process it all—so provide an option for pre-training in which names, features, attributes and states of objects are explicitly shared to prepare new learners. Conversely, learners already experienced with the elements/concepts in the presentation may not need this pre-training—make it optional (Mayer, 2014b; Sorden, 2012).

P11. Spatial contiguity principle. Put labels and comments adjacent to the visuals that they describe. This reduces the amount of effort a learner needs to apply to connect related information (Mayer & Fiorella, 2014).

P12. Temporal contiguity principle. Keep audio and visual content aligned in time. Otherwise you are asking the learner to carry too much information forward in their working memory and less of the information will make it through (Mayer & Fiorella, 2014).

P13. Segmenting principle. Help learners avoid cognitive overload by breaking down the message into manageable chunks so that the learner can assimilate and accommodate new information at a reasonable rate. Keep the segments short—perhaps 8-10 seconds—to allow students to process and master the information before it is displaced from working memory (Mayer & Pilegard, 2014).

Being more effective at designing, storytelling, and problem solving

The process of story development and design is a problem solving process. Consider applying these principles as you engage in creating a learning resource: (*****Note: The phases in your Challenge project are following these principles**)

P14. Problem solving principle (process). Understand the problem; make a plan to approach a solution (often using brainstorming); carry out your plan (create a prototype); and finally reflect on how your solution addresses the problem (can you generalize and consider whether there are other problems available to solve). Be ready to iterate and be flexible. (Polya, 1957; Morra, 2013) (*****Note: The phases in your Challenge project are following this principle**)

P15. Design thinking and collaboration principle. Empathize, define, ideate, prototype, test and repeat. Be flexible and inclusive. Design theory is multi-disciplinary in nature—a single analytical protocol will not work as well as a dynamic team with an eclectic collection of approaches. Build your creative confidence by being mindful of your process and respectful of others' contributions. (Rauth, Köppen, Jobst & Meinel, 2010)

P16. Understand your audience principle. Observe users in order to identify with—and vicariously experience—user feelings, thoughts and attitudes. This will help you find explicit and implicit needs. Look to people generally and your audience specifically for inspiration. By reframing the question in terms of your audience, their challenges and some specific insights into the impacts of the solution, you will have a better understanding of the needs you are addressing. (Rauth, Köppen, Jobst & Meinel, 2010; Roup 2016).

P17. Ideation principle. Brainstorm many ideas without judgement to encourage creativity. This is a process of creating choices—don't shut it down. Once you have a bunch of ideas then organize them, find patterns or themes, and choose what appears to be one of the 'best' choices to explore further (Rauth, Köppen, Jobst & Meinel, 2010). You may come back to you brainstorming ideas for a second or third time as you create and assess prototypes,

P18. Prototype and seek feedback principle. Taking the best ideas and inspiration and creating prototypes is an active and constructive process that allows us to experiment, think creatively, and generate 'concrete' artefacts at intermediate stages. Use sketching, prototyping, and storytelling, and encourage 'users' to share their thoughts. Express your thinking in the terms that are most meaningful to the users to support communication (Rauth, Köppen, Jobst & Meinel, 2010). Seek feedback from both typical and atypical users and plan to iterate.

P19. Plan-script-storyboard principle. Collect your ideas, information and images in rough form first; then thoughtfully organize them in a way that makes sense; next tell a story—don't worry about editing at the start—just tell the story naturally; finally, edit for plot, pace, rhythm, and consistency (Lasica, 2010). A storyboard allows you to clearly connect the images/video with the audio/text in time. It may take several cycles, but a well refined plan will save you hours of effort in the end. "Storyboarding is the first step towards understanding sound and images." (Morra, 2013)

Practical considerations to improve the quality of your projects

Finally, here are some practical principles to help you develop more effective and appealing multimedia projects. Although they attend to cognitive load and affect educational efficiency, they are more focused on technical issues:

P20. Pacing principle. Images and video clips should be on the screen for long enough for the audience to interpret them—for images think 4-6 seconds (Lasica, 2010), video may be longer. Break up the narration and include white space. Interspersing sound (background audio/appropriate music) with narration provides a rhythm. The rhythm can be broken for useful effect, but don't play with it too much.

P21. Animation principle. Static visuals/images can sometimes be just as effective as animated or interactive visuals. Be mindful in your creation and use of features that require extra effort.

P22. Interactivity improves affective response principle. Interactivity, collaboration and learner control all play a role in engaging the learners, although evidence suggests learner control is best for advanced learners (Sorden, 2012).

P23. Guided instruction principle. Guided instruction which also incorporates spacing, worked examples, and feedback, appears to be more effective in supporting learning. Whether discovery learning augmented with guidance is reliably effective is still somewhat uncertain, but it is intuitively appealing. (Sorden, 2012)

P24. Connection principle. Engage the learner in a relationship with the narrator, subject or character. Use a real human voice rather than a machine voice; have conversations (using personal pronouns) rather than interviews or formal presentations; and use gestures and movements to further develop a connection if there is a visual presence. If you have a script, spend some time practicing it and refining it so that it flows naturally in a conversational voice. This will make your voice more personal and help to avoid distracting the viewer from the point of the story. Each of these efforts contributes to the generation of a sense of social responsibility, encouraging learners to try harder to engage and make sense. (Mayer, 2014b; Roup, 2016).

P25. Think about the image principle. Vary the shot types. We tend to use too many medium shots. Occasional wide shots provide context. Closer shots make the video more intimate. Tight shots may be helpful in conveying affective responses and are often memorable (Bloom, 2017). Don't wear out the viewer. Have a purpose for all of your visual information. Use a tripod for your shots. Make sure key elements are clear and properly exposed. Use a simple text font, consistent style, a good color scheme (e.g., no red text on blue background etc.), and limit transitions. Generally avoid pans, zooms, and tilts on live action although they can be used lightly to highlight important information. That said, the Ken Burns effect can be used very effectively, but you need to watch your pace.

P26. Think about the audio principle. Avoid noise and balance your audio so that the user doesn't have to strain to hear key information. Natural background sounds provide context. A clear voice allows us to understand what is being said (use good mics if you can, avoid wind/white noise). Music can fill in the voids and add continuity (Lasica, 2010)—but it shouldn't include vocals unless they add to the story. If it demands the learners' attention it will reduce the learning efficiency of the resource (Mayer & Fiorella, 2014).

P27. Navigation principle. People get less flustered and frustrated when they know where they have been, where they are, and where they are going. Make it so...

P28. Copyright principle. If you are sharing your work publicly, you need to attend to copyright. Use personal, creative commons and royalty free sources. Give appropriate attributions at the end, share it with others, and consider making your work available as an Open Education Resource through a creative-commons license (Wiley, Bliss, & McEwen, 2014).

Goals and Expectations of Principled Resource Creation Assignments

I am providing this guide in EDCI337 in conjunction with four substantive resource creation assignments to give you an opportunity to see the power and potential of applying research supported principles, design thinking processes and problem solving strategies in creating multimedia to support learning. It is intended that these challenges will help you to climb over various thresholds in the creative process and allow you to build confidence in using technology to produce effective resources. It is a model for personalized learning that we all ought to adopt in our professional careers and apply in the challenges we assign to our students in our classrooms. Engagement, enthusiasm and curiosity are infectious—if you model these attitudes in your classroom practice or your training sessions, your students will follow. This leads us to one final principle:

P29. Learn by doing principle. Challenge yourself to create and share manageable multimedia projects as part of your ongoing learning process. Challenge yourself to try something that is new to you. Success leads to further motivation, evolution in understanding, and lifelong learning.

References

Bloom, P. (2017). Visual Storytelling. Retrieved from:
<https://www.youtube.com/watch?v=iWQQgZh9EyE>

Brown, T. (2009). Change by design.

Carroll, M., Goldman, S., Britos, L., Koh, J., Royalty, A., & Hornstein, M. (2010). Destination, imagination and the fires within: Design thinking in a middle school classroom. *International Journal of Art & Design Education*, 29(1), 37-53.

Clark, R. E., & Feldon, D. F. (2014). Ten common but questionable principles of multimedia learning. *The Cambridge Handbook of Multimedia Learning*, 151.

Francis Pelton, L., & Pelton, T. (2009, June). The Learner as Teacher: Using Student Authored Comics to “Teach” Mathematics Concepts. In *EdMedia: World Conference on Educational Media and Technology* (Vol. 2009, No. 1, pp. 1591-1599).

Lindsay, F. (2014) 8 Classic storytelling techniques for engaging presentations. Sparkol. Retrieved from: <http://www.sparkol.com/engage/8-classic-storytelling-techniques-for-engaging-presentations/>

Lasica, J.D. (2010). Digital storytelling: a tutorial in 10 easy steps. Retrieved from: <http://www.socialbrite.org/2010/07/15/digital-storytelling-a-tutorial-in-10-easy-steps/>

McKee, R. (1997). *Substance, structure, style, and the principles of screenwriting*. New York: HarperCollins.

Mayer, R. E. (Ed.). (2014a). *The Cambridge handbook of multimedia learning—Second edition*. Cambridge University Press.

Mayer, R. E. (2014b). Research-based principles for designing multimedia instruction. In V. A. Benassi, C. E. Overson, & C. M. Hakala (Eds.). *Applying science of learning in education: Infusing psychological science into the curriculum*. Download ebook from the Society for the Teaching of Psychology web site: <http://teachpsych.org/ebooks/asle2014/index.php>

Mayer, R. E., & Pilegard, C. (2014). Principles for managing essential processing in multimedia learning: Segmenting, pre-training, and modality principles. *The Cambridge Handbook of Multimedia Learning*, 316.

Mayer, R. E., & Fiorella, L. (2014). Principles for reducing extraneous processing in multimedia learning: Coherence, signaling, redundancy, spatial contiguity, and temporal contiguity principles. *The Cambridge Handbook of Multimedia Learning*, 279.

Morra, S. (2013). 8 Steps to great digital storytelling. Retrieved from:
<https://samanthamorra.com/2013/06/05/edudemic-article-on-digital-storytelling/>

- Pappas, C. (2014). How elearning professionals can integrate storytelling in elearning. eLearning Industry. Retrieved from: <https://elearningindustry.com/7-tips-integrate-storytelling-next-elearning-course>
- Plattner, H., Meinel, C., & Leifer, L. (Eds.). (2010). Design thinking: Understand–improve–apply. Springer Science & Business Media.
- Pelton, T., & Francis Pelton, L. (2008). Technology outreach workshops: Helping teachers to climb over the technology threshold by engaging their classes. *Technology And Teacher Education Annual*, 19(7), 4273.
- Polya, G. (1957). *How to solve it: A new aspect of mathematical methods*. Prentice University Press.
- Rauth, I., Köppen, E., Jobst, B., & Meinel, C. (2010). Design thinking: an educational model towards creative confidence. In DS 66-2: Proceedings of the 1st International Conference on Design Creativity (ICDC 2010).
- Roup, A (2016) 5 principles for engaging storytelling. The Six Skills Global Dialogue. Retrieved from: <http://www.futureorg.org/sixskills/producer/5-principles-engaging-storytelling>
- Soloman, D. (2014). 4 storytelling tips from Ken Burns and his latest film, “The Address”. Retrieved from: <https://www.fastcocreate.com/3029084/4-storytelling-tips-from-ken-burns-and-his-latest-film-the-address>
- Sorden, S. D. (2012). The cognitive theory of multimedia learning. Handbook of educational theories. Charlotte, NC: Information Age Publishing.
- Stanton, A. (2012). The clues to a great story. TEDTalks. Retrieved from: <https://www.youtube.com/watch?v=KxDwieKpawg#t=1m20>
- Wiley, D., Bliss, T. J., & McEwen, M. (2014). Open Educational Resources: a review of the literature. In Handbook of research on educational communications and technology (pp. 781-789). Springer New York.