LEARNING DESIGN TOOLKIT (M.ED. IN IDET)

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Learning Design Toolkit

Learning Theories

Cognitivism

Cognitivism is a student-centered learning theory that centers around the idea that learning and development occur through changes in the mental structure and processes (Lopez, 2025). For example, the way knowledge is used, acquired, and organized is an integral process considered in cognitivism. It is also important to consider the learner's stage of development not just cognitively, but physically as well when designing learning experiences.

In this theory, learning is an active process where the learner takes the new information and organizes it within their own schema of thought. At this point, students either assimilate the new information into their pre-existing schema, or they accommodate their schema to consider the updated information.

Example

The use of graphic organizers is a great example of constructivist theory. Graphic organizers aid students in organizing their thoughts and information in a simple and non-threatening way.
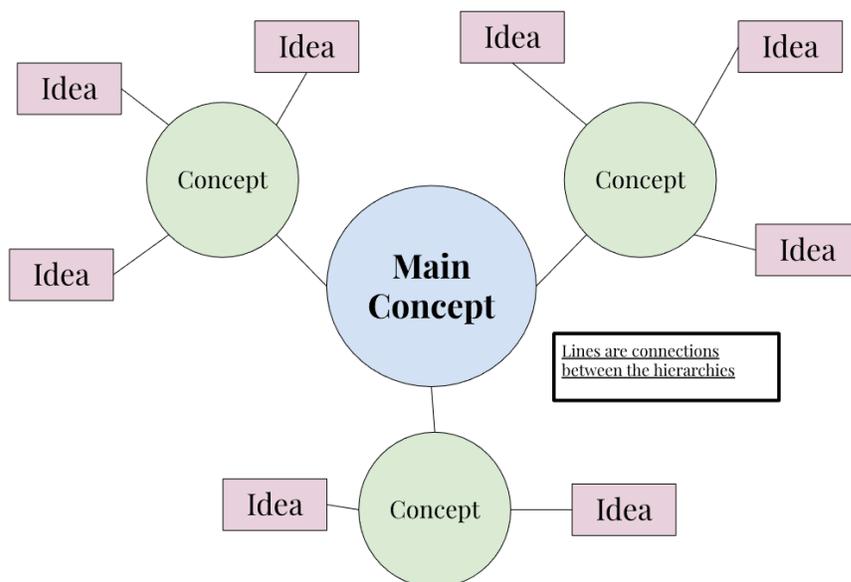
For example, a concept map can be used in most classrooms to help students understand the connections between different topics and concepts. If the main concept is biomes, the concept may be the individual biomes, and from there the characteristics of each. Students can then connect common characteristics to see the connections and compare/contrast the various biomes. This can aid them in accommodating information about new environments that most students have not seen before.

References

Clark, K. R. (2018). Learning Theories: Cognitivism. *Radiologic Technology*, *90*(2), 176–179. https://pubmed.ncbi.nlm.nih.gov/30420575/

Lopez, P. (2025). Behaviorism and Cognitivism Learning Theories in Radiologic Technology Education. *Radiologic Technology*, *96*(5), 371–375. https://pubmed.ncbi.nlm.nih.gov/40880385/

Constructivism

Constructivism learning theory is based around the idea that students construct their knowledge based on their environment and personal experiences. To aid students in constructing new knowledge, teachers act as a facilitator of an active, student-centered classroom (Wibowo et al., 2025). A constructivist environment would also treat learning as a social process and emphasize the importance of communication and collaboration. To construct new knowledge, it is beneficial to be exposed to those with different backgrounds. Communication and collaboration also encourage key skills such as empathy and autonomy.

Example

Metacognition is a great constructivist skill to encourage you to construct new knowledge. To encourage metacognition in students, a teacher could incorporate a self-reflection and assessment before the lesson as well as after. This will allow students to reflect on what they do and do not yet understand. After the lesson, students can look over the new assessment and reflection and see their progress and incorporate the learned information into their own thoughts and understandings of reality.

Reference(s)

Sigit Wibowo, Muhammad Nur Wangid, & Fery Muhamad Firdaus. (2025). The Relevance of Vygotsky's Constructivism Learning Theory with the Differentiated Learning Primary Schools. *Journal of Education and Learning (EduLearn)*, *19*(1), 431–440.
Khalili, H. (2025). Learning theories and their applications in interprofessional education (IPE) to foster dual identity development. *Journal of Interprofessional Care*, *39*(3), 338–347. https://doi.org/10.1080/13561820.2025.2496325

Connectivism

Connectivism is a newer learning theory that is filling the need for new theories due to the increased complexity of the information available to students as well as an exponential growth of the information available (Chandrappa, P. K., 2018). In the modern era, students have access to knowledge on a global scale as well as people from different backgrounds, geographical regions, faiths, etc. The theory proposes incorporating this into a collaborative learning environment. Additionally, knowledge in connectivism is dynamic and ever evolving, meaning we must adapt to these evolutions.

Due to the globalization of information, in this theory learning is not restricted to only the learner, teacher, and geographical community. Now, students have access to a global network of

potential educators and peers. For example, a student who is trying to learn Spanish can get tutoring by a Spanish teacher in Mexico. People can see the local news of many cities around the globe to learn about current events and politics. Due to this, technology can be accepted as a potential mode for learning in connectivism theory.

Example

In both the K-12 and higher education space, connectivism-based activities, such as inviting guest speakers, engaging in discussion and participating in webinars, create a collaborative and connected learning environment.

An example of connectivism-based learning experience in a fully remote classroom would be a reading activity where students are divided into groups of 3-4 and either provided relevant articles or given a topic to find articles online. Then, in a shared location such as SharePoint or Google Drive, students annotate and analyze the document using comments or other, similar features. Once analysis is done, students can then work together to write a summary of the article and give key takeaways. This can be done on video, on audio calls, or over text communications.

Reference(s)

Chandrappa, P. K. (2018). Connectivism as a Learning Theory For The Digital Age. *Adhyayan: A Journal of Management Sciences*, *8*(1), 37-47. http://doi.org/10.11591/ijere.v9i3.20561
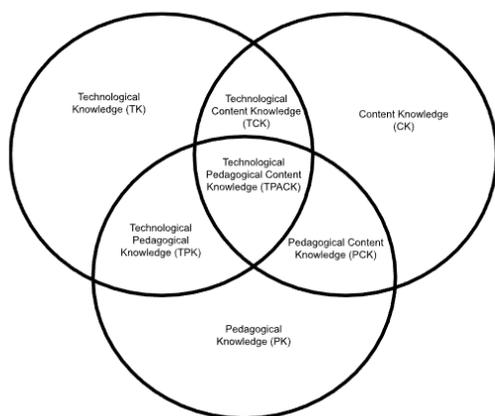
Utecht, J., & Keller, D. (2019). Becoming Relevant Again: Applying Connectivism Learning Theory to Today's Classrooms. *Critical Questions in Education*, *10*(2), 107–119.

Pedagogy vs. Andragogy

TPACK | Technological Pedagogical Content Knowledge

Technical Pedagogical Content Knowledge (TPACK) focuses on technical, pedagogical and content knowledge, as well as the intersection of the three. If you look at the Venn diagram below, technical knowledge (TK), content knowledge (CK), and pedagogical knowledge (PK), are three separate concepts. Where all of them intersect, it is TPACK. TPACK represents the knowledge instructors have when integrating technology while considering the prior knowledge and needs of students. Using TPACK helps guide educators when planning and implementing learning experiences by involving content, pedagogy, and technology simultaneously (Yani, et.al., 2025).

The following list contains a short description of each of the knowledge dimensions and the intersections they create.

- Pedagogical Knowledge (PK): Knowledge of learning theory and implementation
- Content Knowledge (CK): Knowledge of key content concepts and information
- Technological Knowledge (TK): Knowledge of how to use specific technology and learn new technology
- Technological Pedagogical Knowledge (TPK): Knowledge of how to teach about the use and application of specific technology
- Technological Content Knowledge (TCK): Knowledge of what technology can support the learning of the content
- Pedagogical Content Knowledge (PCK): Knowledge about teaching specific content

Example

TPACK can be applied in any classroom for any subject. For example, in a biology classroom, we can use different dimensions of knowledge to enhance the teaching experience for both teachers and students. For example, if there is a lesson on cell organelles and cell functions. A teacher could incorporate the use of a simulation either on a screen or using VR if available where they can see the cell clearly as well as interact with the cell and explore.

The use of VR requires the use of PK, CK, and TK as well as the iterations. PK allows you to understand how to apply the technology and how to apply and incorporate the content. TK represents how we use tech in the lesson and what tech we use. CK is how the content is integrated with technology and taught.

Reference(s)

Paidicán Soto, M. Á., & Arredondo Herrera, P. A. (2024). Artificial intelligence in technical pedagogical content knowledge (TPACK) contexts: A literature review. *Revista Panorama*, *18*(35), 37–54. https://doi.org/10.15765/pkjpwv56

Yani, A., Mulyadi, A., Rosita, & Setiawan, B. (2025). Applying Technological Pedagogical Content Knowledge (TPACK) framework to geography online learning: What can teachers do? *Cogent Education*, *12*(1), 1–16. https://doi.org/10.1080/2331186X.2025.2482395

TAWOCK | Technology Andragogy Work Content Knowledge

TAWOCK is an acronym for Technology Andragogy Work Content Knowledge. In the context of this framework, technology refers to the knowledge of how to use technology to support learning. Andragogy is defined as the knowledge of learning approaches that are content-based and work (industry) oriented. It is an adult learning approach and promotes independence

(Arifin, et. al., 2020). Content knowledge is knowledge surrounding the theories and content of the lesson, and work is the knowledge of industry practices, norms, and needs.

Similar to TPACK, TAWOCK also deeply considers the intersectionality of these four dimensions of knowledge. Below is a list containing the 4 intersections that exist outside of TAWOCK itself (Arifin, et. al., 2020).

- Andragogy Content Knowledge (ACK): Knowledge of how to plan and implement lessons that are digestible and effective
- Technology Andragogy Knowledge (TAK): Knowledge of how technology can support andragogy
- Technology Work Knowledge (TWK): Knowledge of how technology can support work in the industry or workplace
- Work Content Knowledge (WCK): Knowledge of how the content of the lesson interact s with the industry and work

Example

A great example of TAWOCK in action would be the use of VR simulations in medical schools to learn and practice performing laparoscopic surgery. To ensure the learning experience is effective and meets the anticipated objectives, instructors must understand how and why VR technology can enhance the learning of laparoscopic surgery techniques, as well as how these techniques enhance the learner's industry skills. Also to be considered is how to use the VR to enhance work skills in this specific environment as well as what theories would be helpful in implementation.

Reference(s)

Arifin, Z., Nurtanto, M., Priatna, A., Kholifah, N., & Fawaid, M. (2020). Technology Andragogy Work Content Knowledge Model as a New Framework in Vocational Education: Revised Technology Pedagogy Content Knowledge Model. *TEM Journal*.

Arifin, Z., Nurtanto, M., Warju, W., Rabiman, R., & Kholifah, N. (2020). The TAWOCK Conceptual Model at Content Knowledge for Professional Teaching in Vocational Education. *International Journal of Evaluation and Research in Education*, *9*(3), 697–703.

Learning Process Models

Kolb's Experiential Learning Theory

Kolb's experiential learning theory is based on the premise that we learn by reflecting on our concrete experiences, taking away lessons, then applying our new knowledge to unique situations. It is an adult learning theory that is used commonly in management education (Matsuo, 2025). This basic belief is manifested in a four-step process involving two dimensions; the concrete-abstract dimension and the reflective-active dimension (Purdy, 2025). The four steps listed below are part of a cyclical process that can occur in any order.

- Concrete Experience (CE): The actual experience itself

- Abstract Conceptualization (AC): What was learned from the experience
- Reflective Observation (RO): Reflect on the experience and look at it from different perspectives
- Active Experimental (AK): Apply and try what has been learned

Another key aspect of Kolb's Experiential Learning Theory is that there are 4 distinct types of learners who portray and participate in learning differently. Listed next is a list explaining the four learning styles.

- Divergers: Imaginative and Reflective (CE & RO)
- Assimilators: Inductive Reasoning and Theory (RO & AC)
- Convergers: Practical (AK & AC)
- Accommodators: Active learners (CE & AK)

The intersections between the 4 steps of the learning cycle as well as the 4 types of learners is visualized in the image included.
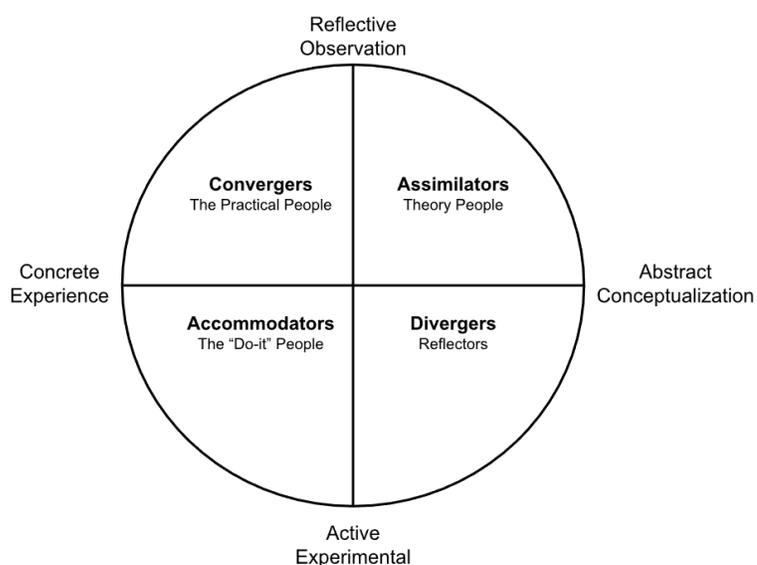
Example

To design a lesson based on Kolb's theory, it is crucial to include opportunities for the full learning cycle. Based on the theory on how the four types of learners interact with the four steps of the cycle; by ensuring all steps are represented in the lesson, all learners will have an opportunity to build confidence and learn effectively.

In an advanced chemistry class, when learning about acids and bases, a teacher can design a multi-day lesson that incorporates all four steps. For the concrete experience, students can perform an acid-base titration lab in small groups to find the amount of acetic acid in vinegar. After, the class will be divided into new small groups where they will discuss and summarize their findings and questions with the guidance of the teacher, representing the reflective observation step. Based on the discussions between students, crowdsource questions from the various groups regarding the lab or topic. Have students research potential answers and theories regarding their questions as well as a few key questions to guide learning to represent abstract conceptualization. Finally, as an assessment and learning opportunity, students can design their own, similar experiment using other substances or testing for other acid/base related phenomena, representing the active experimental phase.

Reference(s)

Matsuo, M. (2025). Supporting experiential learning for expanding successes: extending Kolb's model. *Human Resource Development International*, *28*(3), 423–445. https://doi.org/10.1080/13678868.2024.2401301

Gagne's Nine Events of Instruction

Gagne's Nine Events of Instruction is a model that was created to provide a structure, easy to follow framework for designing learning experiences and enhancing the overall learning experience of students (Sim et. al., 2024). The framework includes nine events that, if they occur, will enhance learning, attention, retention, and transfer. As students progress across Gagne's events, they are more likely to retain the learning and remain engaged (McNeill & Fitch, 2023). It is also important to note that these events do not have to be implemented in order, nor do all events have to occur for learning to also occur. The following is a list of Gane's nine events (Sim et. al., 2024).

1. Gain Attention
2. Inform Learners of Objectives
3. Stimulate recall of prior knowledge
4. Present New Material
5. Provide Guidance
6. Elicit Performance
7. Provide Feedback
8. Assess Performance
9. Enhance Retention and Transfer

Example

Microlearning is a method of learning often used to achieve targeted learning, usually in a shorter amount of time. When creating a microlearning course, it is simple to use Gagne's events to improve the efficiency of these courses.

Ina K-12 classroom, microlearning are often used during review of previous content. For example, if a class is spending time reviewing the topics that have been covered so far, they can use microlearning to do so. To enhance this learning, see the optimizations following and what they correlate to.

- Gain Attention: Teacher can include the use of modern, innovate technology or gamify the modules to gain the attention and engagement of students
- Inform Learners of Objectives: Teacher can provide the learning objectives and standards that students should be working towards at the beginning and end of each module. This ensures that learners consistently see and process the goals of the course

- Stimulate recall of prior knowledge: At the end of each module, teachers can have students update a concept map that they begin during the first module, drawing lines connecting concepts and adding new concepts as they progress and building connections between topics.
- Provide Feedback: Teachers should ensure that students receive consistent, targeted feedback as they progress through the program. For example, explain why an answer is correct or incorrect and allow for correction.
- Assess Performance: Teachers can use a summative assessment at the end of the module that includes various question formats and types to allow students to determine if they have met the objectives
- Enhance Retention and Transfer: End the program with a module focused on simulations and simulated labs to facilitate knowledge transfer

Reference(s)

McNeill, L., & Fitch, D. (2023). Microlearning through the lens of Gagne's nine events of instruction: A qualitative study. *TechTrends: Linking Research and Practice*

Sim Siang Lin, G., Chan Choong Foong, & Abdul Aziz, Y. F. (2024). Interactive Online Modules for Dental Education: A Practical Example of Gagne's Nine Events of Instruction. *Education in Medicine Journal*, *16*(3), 173–184. https://doi.org/10.21315/eimj2024.16.3.13

Continuous Improvement

PDSA Cycle | Plan Do Study Act Cycle

The PDSA Cycle, or Plan-Do-Study-Act Cycle, is a framework used to continuously improve processes for constant improvement. This is done in four phases; plan, do, study, and act. In the "plan" phase, you set a plan for making and assessing the success of improvement. Following is the "do" phase. In this phase, you implement your plan, which is followed by the "study" phase where you study and analyze the results of implementation. The last stage is "act", which is where you act on the discoveries from your results. This is a continuous cycle that should be used consistently and can be used to both create something new and modify something old. It is also great for improving processes in a short time frame in an organization (Ungvarsky, 2025).

Example

There are two situations in which you should use the PDSA cycle; when creating something new or improving something previously made. If a tasked with designing a new course, I can use the PDSA model to plan a big picture timeline, budget, etc.

1. Plan: Determine the objectives of the course, what methods will be used to achieve those objectives, as well as any other considerations.
2. Do: Create the course and release it to a small beta group for testing (e.g. survey, user data, etc.)

3. Study: Analyze the results of testing. What did the users say and how did it impact the course?
4. Act: Implement changes based on the findings of the release

If I am tasked to update and enhance an existing course, I can still use this cycle; it will just be applied in a slightly different way.

1. Plan: Decide what changes need to be made, how to implement the changes, and administrative factors such as budget and manpower.
2. Do: Implement the changes and release them to the public
3. Study: Implement feedback programs for feedback from users, as well as using analytic data collected through the course to determine technical needs
4. Act: Use collected data to further refine the curriculum based on student and teacher needs

Reference(s)

Ungvarsky, J. (2025). PDSA cycle. *Salem Press Encyclopedia of Health*.
https://www.ebsco.com/research-starters/health-and-medicine/pdsa-cycle

Design Models

First Principles of Instruction

Merrill's Principles of Instruction

Merrill's Principles are a set of common principles that underly effective instruction. These principles center around real-world, problem-based learning experiences and serve as a framework for learning experiences that are active, engaging, and impactful. Using this framework improves students' meaningful learning when properly incorporated into the curricular design (Badali et. al., 2022).

Merrill stated that his principles should follow a four-phase cycle centering around a specific task or problem, ensuring effective instruction. The first is activation, where relevant prior knowledge is activated. Next is a demonstration, where the skill is shown to the learner, followed by application, where learners use the skills and knowledge to solve a unique problem. Finally, at integration, learners integrate their skills into their everyday life.

Example

A great example would be a forensic case study that takes place at the end of a forensics class at a high school. The case study will be surrounding a "murder" that occurred in the school that students must solve. Instructors start a short documentary (For example, Forensic Files) that shows how forensics is used to solve crimes in the real world. Then, have stations set up involving various forensic techniques such as blood splatter analysis. Demonstrate the process of using each of these skills. Students will go to various stations in small groups to analyze their evidence and attempt to solve the case. At the end, a whole group discussion on true murder will act as a final assessment for students.

Reference(s)

Badali, M., Hatami, J., Farrokhnia, M., & Noroozi, O. (2022). The effects of using Merrill's first principles of instruction on learning and satisfaction in MOOC. *Innovations in Education & Teaching International*, *59*(2), 216–225. https://doi.org/10.1080/14703297.2020.1813187

Tu, W., & Snyder, M. M. (2017). Developing conceptual understanding in a statistics course: Merrill's First Principles and real data at work. *Educational Technology Research and Development*, *65*(3), 579–595.

Merrill's Four-Phase Cycle of Instruction
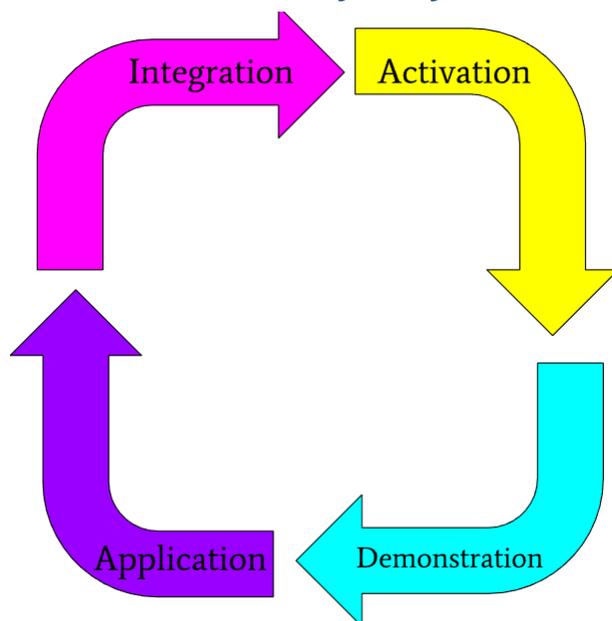
This cycle of instruction is based on Merrill's Principles of Instruction. Using this cycle as a framework helps to ensure the creation of effective, engaging, and active learning experiences. The cycle begins when you activate prior knowledge, followed by a demonstration of the new knowledge to learners. The learners then apply the newly acquired knowledge before integrating it into their lives (Badali et. Al, 2022). These activities should be problem centered and have authenticity.

Example

In a 12th grade anatomy class, students will be solving a problem of x-rays that came into the class to diagnose the issue the patient is having. Students will divide into small groups and, using prior knowledge, determine their initial thought on the diagnosis. The instructor will show another x-ray and explain the diagnostic process using the x-ray as an example. Based on the demonstration, students will research and examine the x-rays again to determine the final issue. Once the group has determined their diagnosis; they will present it to the whole group.

Reference(s)

Tu, W., & Snyder, M. M. (2017). Developing conceptual understanding in a statistics course: Merrill's First Principles and real data at work. *Educational Technology Research and Development*, *65*(3), 579–595.

Project Management Models

Agile

Agility is defined as the ability to make rapid process changes to achieve operational flexibility (Nunziata, 2024). In the agile model, there is a network of self-operating teams brought together by cocreating value for stakeholders, supported by learning mechanisms, fast decision cycles, extended use of technology, in a people centered environment. Agile fosters productivity, open communication, and collaboration through transparency, mutual respect, and self-management. Agile is planned in small cycles called sprints. Teams are composed of people across departments from various backgrounds to ensure a blend of ideas.

Example

If you are designing an eLearning course for SAT prep, you can use the agile process to enhance the implementation and product. First, determine the objectives and the scope. What

score are we trying to achieve? What are commonly tested topics? The agile team then collaborates to build the architecture of the course, including framework, design, user experience, and accessibility. The product is then built before an Agile team tests the product to provide feedback before release, when it is rolled out to users. After the rollout, continuous feedback and revision helps the course stay up to date and effective.

Reference(s)

Codington-Lacerte, C. (2025). Agile software development. *Salem Press Encyclopedia*.

Nunziata, E. (2024). Beyond the Agile Model: Overcoming Instability with Resilience. *Economia & Management*, *4*, 73–78. https://doi.org/10.1485/1120-5032-202404ENG-9

SAM | Successive Approximation Model

SAM or the Successive Approximation Model is a type of agile framework that is rapid, iterative, and interactive. This model has shorter development cycles due to the agile framework and chances for feedback are built in for periodic improvement. There are two versions of the model, SAM 1 for smaller groups, and SAM 2 for larger projects (Ali et. al., 2021). SAM1 is a single cycle that includes evaluation, design, and development. SAM2 is for larger projects and includes 3 phases. The preparation phase is where information is gathered. During the iterative design phase, which is cyclical, the product is designed, prototyped, and evaluated. Finally, in the iterative development phase, the product is developed, implemented, and evaluated.

Example

SAM1: Create a TPT online interactive activity

- Evaluate 1: Determine objectives of activity, assessment being used for activity, time it will take, etc.
- Design 1: Determine activity details, such as the individual parts of the activity, how it will be presented, etc.)
- Develop 1: Create interactive activity using needed program, release online
- Evaluate 2: Use customer feedback, sales data, and current information to evaluate effectiveness, validity and usability of the activity
- Design 2: Incorporate these changes into the activity (Update content, fix bugs, etc.)
- Develop 2: Release changes in public and ensure the effect of the changes

SAM2: Writing a new science schoolbook for classroom use

- Phase 1: Background
  - Info Gathering: Determine current market needs regarding science, research state standards for schools, how will we present the schoolbook (virtual, print, etc.)
- Phase 2: iterative design phase (Is used in a cyclical fashion)
  - Brainstorm ideas from all stakeholders
  - Plan how project will be built

- o   Polish initial designs
- Phase 3: Iterative development phase, cyclical
    - o   Alpha: Phase 1 built for initial design testing
    - o   Beta: Modified version of alpha with finalized structure, content, etc.
    - o   Gold: Final release of product based on polishing the beta release

Reference(s)

Ali, C. A., Acquah, S., & Esia-Donkoh, K. (2021). A Comparative Study of SAM and ADDIE Models in Simulating STEM Instruction. *African Educational Research Journal*, *9*(4), 852–859. https://eric.ed.gov/?id=EJ1324100

SAMR | Substitution, Augmentation, Modification, and Redefinition

SAMR of Substitution, Augmentation, Modification, and Redefinition, is a framework that explains the various types of tech integration (Warsen & Vandermolen, 2020). The first type, substitution, is when technology is a direct substitution for a tool with no functional change. If there is a functional enhancement, that is augmentation. Modification is when technology allows for significant task redesign and redefinition is when tech allows for the creation oof new tasks that were previously inconceivable.

Example

- Substitution: Using Quizlet or Anki Flashcards rather than traditional paper index cards to study, improving efficiency of card creation
- Augmentation: Use the online platform to share decks with others to collaborate in studying, increasing motivation due to increased collaboration
- Modification: Use AI to turn virtual flashcards into study guides, practice tests, etc., allowing students to use different ways to study to fit their needs
- Redefinition: Using a flashcard program to add audio, gifs and visuals to enhance learning and differentiation that is not possible on paper cards

Reference(s)

Warsen, G. D., & Vandermolen, R. M. (2020). When Technology Works: A Case Study Using Instructional Rounds and the SAMR Model. *Education Leadership Review*, *21*(1), 163–177. https://eric.ed.gov/?id=EJ1279809

Waterfall

The waterfall method is a method of project management where each phase of the project is completed sequentially linearly with well-defined procedures for concerns. One phase must be completed before moving to another (Iacob et. al., 2024). Though there is variation in the potential phases, Iacob et. Al (2024) suggests 6 general phases.

- Analysis & Requirement Specification: Outline final product, define workflows and resources, establish acceptance criteria for product delivery
- Solution Design: Uses complete info from phase 1 to fully define product

- Implementation: resources distributed equitably so the final product is delivered as agreed upon in the previous phases
- Testing & Acceptance: Final product is tested to confirm product meets expectations and functions
- Solution Installation: Product delivered to user
- Maintenance: Remain to fix errors, support users, etc.

This method works well for projects with well-defined requirements, predictable outcomes, and lacks flexibility. This provides a clear structure, documentation, and planning from project planning.

Example

Create a YouTube series covering the process of photosynthesis

- Analysis & Requirement: Determine general outlines for the project, timeline, and workflow for the videos.
- Solution Design: Determine number and length of videos in the series as well as order of content, write the scripts and create visuals
- Implementation: Determine a plan for video release and allocate tasks and resources equitably to the team (Will they be released all at once or once at a time? etc.
- Solution Installation: Quality insurance (Play the videos, check that things such as closed captions and audio descriptions function as intended, etc.)
- Maintenance: After the release of the videos, periodically update any videos if new information arises, collect user data to better cater to the correct audience, etc.

Reference(s)

Iacob, A. T., Stana, C., & Budu, R. A. (2024). Boosting human capital: how the COVID-19 pandemic accelerated agile methodology adoption in software development. *Theoretical & Applied Economics*, *31*(3), 243–252.

ADDIE | Analysis, Design, Development, Implementation, and Evaluation

ADDIE, or Analysis, Design, Development, Implementation, and Evaluation, is an educational design framework that can form a basis for real-world education (Ali et al., 2021). It is a type of waterfall method of design; however, it can be easily altered to match various situations (Lasky, 2024). Though the ADDIE method is traditionally used in adult educational spaces, it can be applied to K-12 education and other situations as well.

The five steps of ADDIE are completed sequentially and in a linear fashion. One step must be completed before the other.

- Analyze: Identify key details like intended audience, instructional goals & objectives, and prior knowledge
- Design: Develop outline/ blueprint for the project including making the structure, content, assessment methods, and resources needed for the learning experience

- Develop: Actually, implement plans from last phase and create the real-world content
- Implement: Prepare product for use by the public, develop procedures for using the product, all resources for the product are ready to use, final testing for functionality
- Evaluate: After release, seek feedback to determine the effect of the product in the real world. Did the product meet the intended goal?

In the age of digital development, this model has often been criticized for its linear nature; however, it has been modified several times for various situations, increasing its flexibility.

Example

Designing a unit over astronomy for middle school science

- Analysis: Identify the amount of time you can take for the lesson, what resources are available to you, the prior knowledge required for students, etc. (In this case, a unit outline, look at other, similar lessons/ units as research)
- Design: Design learning objectives, assessments and resources (Writing individual lesson plans)
- Development: Create actual lesson materials (Create presentations, set up the learning management system with assignments and assessments, create note sheets and prepare lab documents)
- Implementation: Release the unit to students (Release materials that were waiting on the Learning Management System and have the instructor follow and teach unit)
- Evaluation: Evaluate if goals were met (Compare student competency before and after the unit, discuss potential improvements with students and teachers, update unit based on this feedback)

Reference(s)

Ali, C. A., Acquah, S., & Esia-Donkoh, K. (2021). A Comparative Study of SAM and ADDIE Models in Simulating STEM Instruction. *African Educational Research Journal*, *9*(4), 852–859. https://eric.ed.gov/?id=EJ1324100

Cognitive Load

Module 3

Managing Cognitive Load

Signaling

Signaling can be defined as cues given to the learner to indicate how they are meant to process the learned material (Mautone & Mayer, 2001). The use of signaling is beneficial because it can guide cognitive processing, which in turn increases recall and performance. The extraneous

load is reduced with the use of signaling because it guides the user's attention to the key content (Paul, 2021). Signaling is a method that can work in multiple modalities, such as text, speech, and video. However, it is important to avoid unnecessary distractors, like decorative graphics, animations, and text. If they are overused, the cues lose their significance, so signals should be used sparingly and only when beneficial.

Example

Creation of a New Hire Training document

- Key terms and acronyms will be bold to draw attention to them and stress the key vocabulary. In addition, they should be underlined as they should link to a definition of the term. Using color is avoided due to accessibility concerns, but new hires are free to use color to add cues to their own version of the document.
- Include a consistent Heading structure and format throughout the document that can be used to guide learners to the correct information or resource as they need it. If possible, a table of contents can enhance this greatly. In addition, if this is done online in a word processor, the heading structure can be embedded into the document to work no matter what platform it appears on and allow enhanced organization.
- Include graphics, such as a pathway graphic or timeline, that outline each process in the document and summarize the concepts. For example, if there is a linear or somewhat linear process for the job, creating a process map that shows the process at a higher level with help learners understand how they will be learning the material.

Reference(s)

Mautone, P. D., & Mayer, R. E. (2001). Signaling as a cognitive guide in multimedia learning. *Journal of Educational Psychology*, *93*(2), 377–389. https://doi.org/10.1037/0022-0663.93.2.377

Paul, M. (2021). *Signaling in Training*. DigitalCommons@University of Nebraska - Lincoln. https://digitalcommons.unl.edu/qicwdumbrella/18/

Chunking

Chunking can be defined as the increase in use of short-term memory when information is combined into groups (chunked) rather than staying as individual pieces (Ungvarsky, 2024). This is based on the thought that humans have a limited capacity for information in our short-term memory, approximately 5-9 pieces of information. Chunking creates meaningful chunks that can help with memory. These chunks can be created by combining unrelated pieces of information into shorter, easier to retain units. Chunking can also be done using patterns, such as categories of food, to increase memorization. The final methos is to regroup information to better integrate it into memory based on new chunks.

Example

The Japanese Alphabet is a wonderful example of the use of chunking for language acquisition. Due to historical events, Japan has a variety of writing systems which are used together often. This leaves many characters that one would need to know to be literate. To help with this, the

writing system is divided into 3 groups; Kanji, Hiragana, and Katakana. Kanji are Chinese characters that are often used for nouns and word stems. Chunking them together makes sense due to their complexity and specific use. Hiragana is used to write native words and grammatical conjugation, grouping them for their grammatical usefulness. Finally, there is katakana, a system used for foreign words. Using this system, readers are able to remember hundreds of characters, but also derive meaning based on the type of characters seen.

Reference(s)

Ungvarsky, J. (2024). Chunking (psychology). *Salem Press Encyclopedia*.

Visual Cognitive Load/C-R-A-P

Visual cognitive load is the cognitive load carried due to visual stimuli. Visual load can be overwhelming when dealing with significant visual input, such as overwhelming color or tightly packed media. To prevent visual cognitive overload, an acronym, CRAP, was created to identify the 4 key principles of visual design.

- Contrast: Make certain elements visually interesting for emphasis
- Repetition: design consistency through methods such as repeated colors, fonts, etc.
- Alignment: Uniform flow visually, aligned spaces and content
- Proximity: Related aspects are near each other (shows the relationship)

Using these principles improves not only the visual appeal and ease of use opf the project. But enhances the effectiveness and effect due to decreased extraneous load.

Example

The task is to create a webpage with different diagrams of the human body, the organ system versus the skeletal system. The goal is to allow students to better understand the relationship between the two in relation to position and function.

- Contrast: Key aspect of diagram increased brightness and opacity while other things, become darker and more transparent
    - When organ system diagram is selected, the human skeletal structure becomes translucent, so users can see the interaction between the two, but the focus is on the skeleton due to the contrast
- Repetition: Keep consistent font, writing style and art style. Keep controls, such as buttons or arrows consistent visually
- Alignment: Make sure diagram descriptions are in line with the rest of the diagram. The text will all be left aligned. The buttons should align with the diagram as well. A grid system can be used to ensure consistent alignment
- Proximity: Have information about the skeletal system grouped around the skeletal system graphic, organ system info around organ system graphic

Reference(s)

Kimball, M. A. (2013). Visual Design Principles: An Empirical Study of Design Lore. *Journal of Technical Writing & Communication*, *43*(1), 3–41. https://doi.org/10.2190/TW.43.1.b

Powell, O. (2022, October 11). *4 CRAP design principles for a better UX*. Attention Insight. https://attentioninsight.com/crap-design-principles/

Strategies for Student Learning

Scaffolding

Scaffolding is a way to support students in learning new concepts. It helps students meet objectives by slowly introducing the student to the skill and letting them practice and learn before performing the skill independently. Scaffolding breaks the tasks down into more manageable steps and fosters a sense of ownership and independence as students progress. It is also a wonderful differentiation technique because it allows the teacher to tailor their lesson to assist based on student needs. Student engagement increases with this method due to the increase in student ownership as well as the decrease in frustration due to scaffolding.

Example

An example of scaffolding can be the "I do, we do, you do" method often used in middle and elementary school classrooms. In this model, the teacher will begin the lesson by demonstrating the skill, such as writing a paragraph. The teacher then guides the students as they do the skill together, such as a class paragraph. Finally, the students write their paragraphs independently and apply the skill. In this way, the students are slowly guided through learning and slowly gain independence.

Reference(s)

Boman, M., Jhun, P., & Schaekermann, M. (2025). Scaffolding for success: Blending learning with and about Generative AI in medical education. *Medical Teacher*, *47*(12), 1911–1917. https://doi.org/10.1080/0142159X.2025.2571041

Levels of Challenge

Levels of challenge are a means to encourage students to learn from the struggles of challenging experiences to progress through the learning process. There are various frameworks used for this model, one of which is Bloom's taxonomy. In Bloom's taxonomy, student knowledge is described based on the taxonomic level of understanding the student has. The 6 levels are remembering, understanding, applying, analyzing, evaluating, and creating. In this scenario, the levels of challenge increase as you progress through taxonomy. Webb's depth of knowledge is also among other frameworks used to determine levels of challenge.

Example

In a classroom of students studying photosynthesis, the levels of challenge may progress in the following way

1. Remembering: Students remember that photosynthesis is how plants get their food
2. Understanding: Students understand that plants turn light into energy through the process of photosynthesis
3. Applying: A student can explain the process of photosynthesis using a diagram
4. Analyzing: Students determine various factors that may affect photosynthesis and what that effect may be
5. Evaluating: Students evaluate the process of photosynthesis and how it effects the plant
6. Creating: Students create an experiment to test how photosynthesis is changed by various external conditions

Reference(s)

Boslaugh, S. E., PhD. (2022). Bloom's Taxonomy. *Salem Press Encyclopedia*.

Active Learning

Berek (2025) states that active learning involves the learners working either independently or in groups to construct new knowledge, focusing on skill development rather than transfer of knowledge from teacher to student. Students interact directly with the learning material in a meaningful and impactful way, such as an experiment or discussion. Active learning encourages higher-order thinking by having the learner take accountability for their own learning and skills. They must use metacognition and other cognitive skills to introduce new knowledge into their schema as they complete the task. The student-centered aspect of active learning is greatly student-centered and fosters transference.

Example

Students will be tasked with a project-based assessment where they are tasked to make a 2–5-minute TikTok video explaining the process of photosynthesis to peers. This project could be done in groups or individually. Students actively participate in their learning by culminating their skills into one project. Through summarization, creation, and other higher order thinking skills, they are more likely to retain the skills they learned and increase transference to novel situations.

Reference(s)

Berek, D. L. . M. (2025). Active learning. *Salem Press Encyclopedia*.
https://research.ebsco.com/linkprocessor/plink?id=6d40b830-f21f-3faa-8232-88c2d14af2aa

Problem-Solving Tasks

A problem-solving task is defined as an open-ended, unique, and complex task that addresses a novel problem or situation. Learners are asked to define the problem, identify the cause, then identify and implement the best solution. The problem should have more than one solution, and solutions should be backed by student skills and learning. Due to the nature of problem-solving tasks, they may elicit some intense emotions in learners, such as confusion, curiosity, and astonishment. These are important in the knowledge construction process for students because it allows the student to use metacognition to assimilate new information into their current schema of knowledge.

Example

In this lesson, students will be presented with a real scientific study that has been put forward. The students will be told that they will be reviewing the papers to see which are to be published and which should not be published. They were tasked with determining the validity of the paper and making an argument about the validity with evidence. Some key skills in problem-solving are collaboration and communication. To encourage these skills, students will be put into groups of three. After, students will use their knowledge of scientific validity, experimentation and research along with academic resources to determine the validity of the research. They will then construct a presentation with evidence to argue about the validity and either allow or prevent the paper from being published.

Reference(s)

Stuppan, S., Rehm, M., Tessa, & Wilhelm, M. (2025). Do STEM education problem-solving tasks trigger learners' epistemic curiosity? And why we should be astonished. *International Journal of STEM Education*, *12*(1). https://doi.org/10.1186/s40594-025-00557-z

Knowing the Learner

Learner and Context Analysis

Sociocultural Factors

Sociocultural Theory

Sociocultural theory was developed by Russian educator Lev Vygotsky to understand how culture and society impact the cognitive development of children. Vygotsky argues that students appropriate the ideals and structures of their community due to cultural differences in cognition and intelligence. No singular culture is inferior to the other; the point of this community's learning is to help learners adapt to the environment and community around them. It is important to study the cognitive processes that are involved in the relationship between adult instructors and children in an educational setting. Furthermore, when students interact with instructors within their community, they learn through modeling by adults or more knowledgeable community members. In turn, children become explorers that are actively participating in their learning through the discovery of new information as they mirror the behaviors (Mercadal, 2021).

Based on the sociocultural theory he developed, Vygotsky developed a framework, the Zone of Proximal Development (ZPD), which is a visual representation of differences between av learner's current capabilities and what they are striving to achieve. The larger the gap between the student's current skills and the goal, the more skills need to be developed to reach that goal. The actual ZPD is the area right outside your current skills, where students complete tasks in this zone to gain new skills. It is important not to be too ambitious, as the farther the skill is from the ZPD, the more likely a student will get frustrated and lose motivation. This zone is different for every learner, so using methods such as scaffolding and discussion allow differentiation to get every student to that zone. The graphic below illustrates the zone of proximal development (Flair, 2024).

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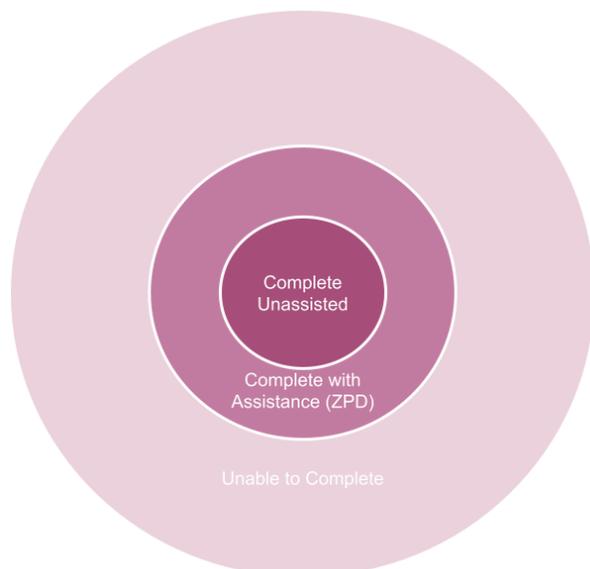
Example

Community is a key concept in sociocultural theory; therefore, my examples are based on community interaction. An interaction that can be beneficial is the use of peer tutoring, where older/ more knowledgeable students guide younger/ less experienced learners in developing needed skills. For example, In a high school, a general biology class containing 9th-10th graders can invite the A.P. Biology students, who are usually 11th-12th graders, tutor their students. This is beneficial because students are usually more comfortable conversing with those of a similar age and vernacular. These tutoring opportunities allow the tutee to learn through the guidance of the tutor, and the tutor is able to explain and model the skill, enhancing higher order thinking.

Another example would be to invite guest speakers or instructors from the community into the classroom. Mercadal (2021) states that children need to participate in the world due to the collaborative nature of cognitive development. Bringing community members in is a wonderful way for students to learn from more experienced people. For example, an instructor teaching an anatomy and physiology class may invite a doctor from the local hospital to explain how anatomy is used in medicine. This will not only spark student interest and motivation, but they will also be able to make real-world connections between class content and medicine.

Reference(s)

Flair, I. (2024). Zone of proximal development (ZPD). *Salem Press Encyclopedia*.

Trudy Mercadal, P. (2021). Sociocultural Theory. *Salem Press Encyclopedia*.

Universal Design for Learning

Universal design for Learning (UDL) is defined by Eagleton (2024) as a way to design, create and manufacture projects and experiences that are available to the most people possible, without the need to adapt or modify the program. In this case, the term "universal" does not

mean the same for all users but acknowledging user differences and integrating support for all users. UDL is based on the idea that we should make materials flexible preemptively rather than on the spot during use. There are 3 main aspects to UDL; the first is to incorporate representation of users, whether that be race, gender, religion, or other key characteristics. Users should also have multiple ways to learn and show their knowledge that they gain through the program. Finally, there should be multiple ways to keep students engaged, whether it be visuals, novel uses of technology, or other means. Eagleton (2024) proposes seven basic examples of UDL that can help incorporate all three main concepts.

1. Equitable Use: Users of various backgrounds and support needs can use the product
2. Flexibility in Use: The program accommodates both user needs and preferences
3. Simple and Intuitive Use: How to use the program can be determined reasonably easily during use
4. Perceptible Information: The information can be transmitted regardless of ability or situation
5. Tolerance for Error: There are minimized consequences for unintentional actions
6. Low Physical Effort: The user can use the program without physical discomfort or issues
7. Size and Space for Approach and Use: There is a reasonable amount of space surrounding every clickable media to allow users to navigate more easily when clicking

Example

There are many ways to incorporate Universal design for learning. For example, if someone is designing an eLearning program discussing chemical bonds, UDL can be used to ensure the program is as accessible as possible to as many learners as possible. According to UDL, we can use the seven basic UDL examples to enhance the motivation and learning of the learners

1. Equitable Use: In the program, ensure that the design of the learning is simple and easy to follow to increase ease of use for everyone.
2. Flexibility in Use: The learning will have optional closed captions on any videos or simulations, as well as the ability to increase or decrease the speed to adjust to the user's needs or preferences
3. Simple and Intuitive Use: The design of the eLearning program should be consistent throughout, as well as the functionality. Buttons will be in the same position and clearly labelled, among other user experience essentials
4. Perceptible Information: In videos or simulations, having subtitles available will allow users to be able to read the information if they are unable to hear. Furthermore, audio descriptions will hel;p if students cannot see the video's key imagery
5. Tolerance for Error: In the program, if there are activities involving typing, spelling will not be a factor in grading within reason. Instead, multiple common spellings of the answer will be accepted, with a message providing the correct spelling as feedback.
6. Low Physical effort: The use of text-to-speech or speech-to-text capabilities greatly decreases the physical effort needed for users to type or read aspects of the program that may be challenging or inconvenient to do otherwise.

7. Size and Space for Approach and Use: Having adequate spacing between controls is beneficial for everyone. This will allow for a larger area where the click is registered, easing burden of use

Reference(s)

Eagleton, M. (2024). Universal Design for Learning (UDL). *Salem Press Encyclopedia*. https://research.ebsco.com/linkprocessor/plink?id=c4c5ae2c-a4bc-3afe-8693-e5c49a1d95de