Intro to Learning Sciences

Lectures 27 and 28, Nov 18 and 20, 2025
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Collaborative Learning: Meanings of collaboration

- Situation:
  - Symmetry: Objective or subjective
    - of action
    - of knowledge, skills or developmental level: slight knowledge asymmetry is desirable but largely symmetrical
    - of status
  - Common goals
  - Division of labour
- Interaction:
  - Interactivity: Interactions must influence peers cognitive processes
    - Dialogues that are constructive
    - Turn-taking
    - Sharing task - related information
  - Synchronicity: of reasoning, need for mutual modeling
  - Negotiability: No imposition of viewpoint, argument, justification, attempt to convince
    - Space for negotiation: there should be something to negotiate about, either about the task or about how to interact; grounding + negotiation
    - Space for misunderstanding in grounding: misunderstanding -> explanation and other good learning processes -> optimal collaborative effort

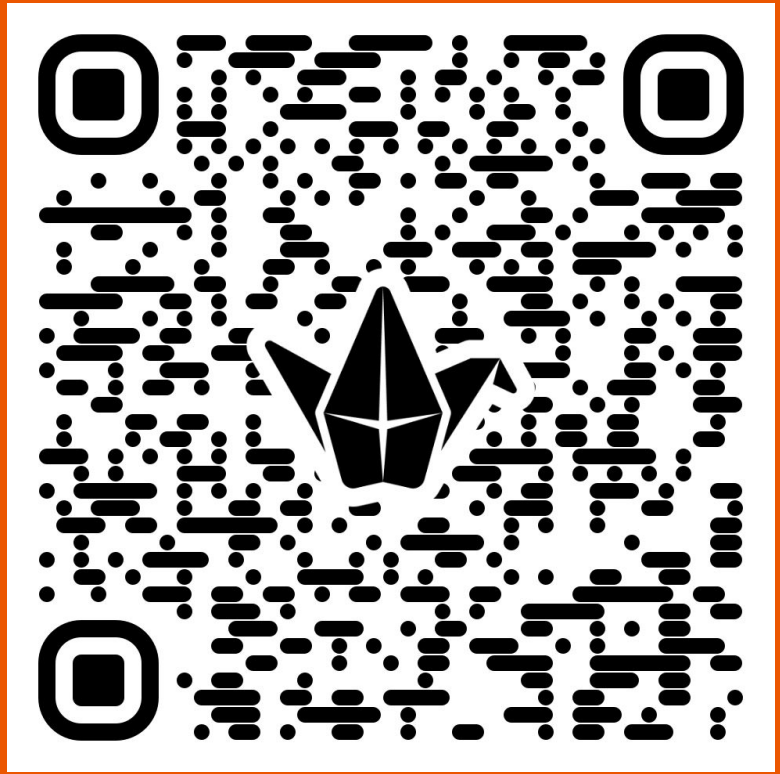
Collaborative Learning: Nature of collaboration

- Success Mechanisms:
  - Constructing common ground
  - Inductive - joint action involves some level of abstraction
  - Decrease task related cognitive load (increase working memory resources), increase interaction related cognitive load
  - (Self) - explanation
  - Conflict
  - Internalization *(effect)*
  - Appropriation: reinterpretation of own action in the light of what his partner does
  - Mutual modelling
  - Cueing each others knowledge
  - Complementary knowledge or skill - pooled knowledge
  - Error correction
  - Re-exposure
  - Relearning through retrieval
  - Observational learning
  - Increased engagement
  - Joint management of attention
  - Negotiating multiple perspectives

- Failure Mechanisms:
  - Memory coordination
  - Retrieval disruption
  - Production blocking
  - Social loafing
  - Fear of evaluation

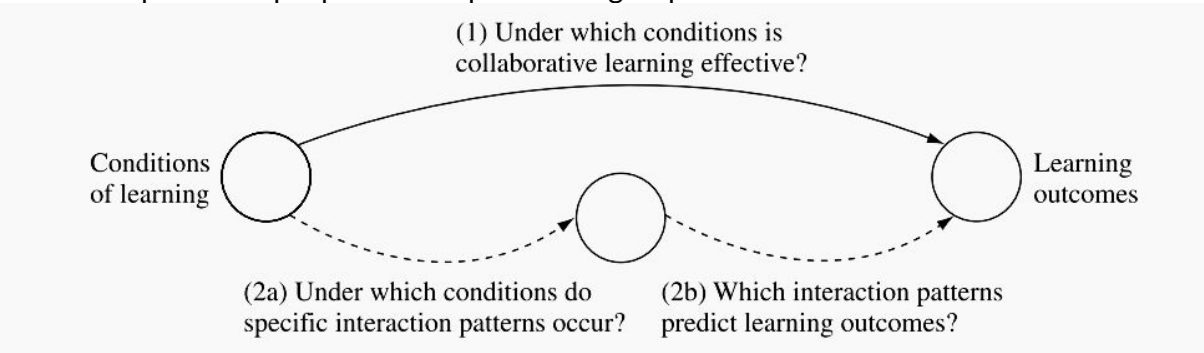
Analysis of previous collaborative work:

Which mechanisms of collaborative learning success and failure do you conjecture were at play in the activity?



Collaborative Learning: Effects of collaboration

- Effects: What to measure?
  - Effects of particular interactions
    - Zoom in on particular interactions and understanding underlying mechanisms
- Effects: How to measure?
  - Group or individual
    - Group because people need to perform in groups



Theories of learning

- Connecting situation, interactions, processes and effects
- Situation <-> Interaction patterns <-> Cognitive mechanisms <-> cognitive effects

How to engineer interactions for learning?

1) Collaborative learning can be better than individual learning for some memory and problem solving tasks but lot of variation in terms of nature of tasks, level of learner
2) Affordances and constraints of activity, what types of knowledge do students bring, mechanisms that underlie successful collaboration
3) Initial conditions interact in complex ways - group heterogeneity is different for different tasks
4) Roles
    a) Reciprocal teaching
    b) Take a particular argumentative viewpoint
    c) Different visual viewpoints
    d) Control data access

How to engineer interactions for learning?

5) Interaction Rules

a) Everyone must speak
b) Sentence openers (“I propose that …”, “I disagree because …”, and so on)

6) Monitor and Regulate

c) Teacher monitors and provides feedback
d) System monitors and provides feedback (or gives input to the teacher)
e) Students self-monitor with the support of tools (who is speaking, who is acting, how much interaction, and so on)

Interest, Motivation, Engagement and Learning

*Case 1: Nasir**	*Case 2: Emily*
Nasir's eyes lit up when asked about his major in computer science (CS). Coming into college, Nasir had no idea what CS was. He assumed that he would be pursuing chemistry and only decided to take an introductory CS course because his friends were signing up for it. He explained, "CS [computer science] feels like art, like drawing." He described the first course, saying, "We all worked on designing a slot machine that worked. In the end, they did, and they were all different. We would look at each other's efforts to build a slot machine and laugh (even when it wasn't working). There wasn't a better or best answer. In the end, it came down to you and how you think of the problem." He explained that the project focus was novel for him and a contrast to the advanced chemistry course in which he was also enrolled. He said, "The [chemistry] lab journal felt unreasonably strict, and everything felt like a procedure," and noted that even though chemistry had been his intended major, he switched to major in CS after taking more classes and doing a summer internship as a software engineer. He described CS as challenging and at the same time doable, and the kind of thing that he and his friends had fun hanging around thinking and talking about.	Emily says that dance is an important part of who she is, but reports that it was not always this way. She started taking ballet classes at the age of 5. She looked up to the older dancers as role models, and worked hard in class to impress her teacher, who challenged and encouraged her. Each year Emily took more classes and performed more roles. Age 10 was a critical year for her. "I remember when I was 10, my teacher moved me into the advanced class, and I felt so out of place. I didn't think I'd ever be as good as the older girls. The steps were too hard for me, and I wanted to quit." She explained that instead of boosting her confidence, being moved into the advanced class lessened her self-efficacy. She left most classes feeling discouraged, but continued to attend them because of her mother's encouragement. That spring, her teacher announced that the following fall Emily would be ready for her first pair of pointe shoes (which she knew everyone got at age 12, not 10). "When my teacher said I was ready for pointe, my whole perception changed. I came to class every day working hard to make her proud and prove that I could do it. With pointe shoes, I could show everyone that I really was a ballerina." Emily persevered through the challenging exercises and continued into company classes and pointe work, earning more lead roles in the annual performances.

Interest, Motivation and Engagement

- **Motivation:** Will to engage, its effect on setting goals and working, affected by
  - Perceived value of task
  - Belongingness
  - Self-efficacy for task
  - Intrinsic and extrinsic goal orientation
  - Anxiety
  - Perceptions or beliefs about achievement, capability, or competence
  - Expectancy (likelihood of benefit from one versus another action)
  - Choice
- **Engagement:** Individuals cognitive, affective and behavioural responses to the context of participation, reflecting their beliefs about the possibility of their participation
  - Cognitive: Investment, willingness to exert effort to attain mastery
  - Behavioural: Continued participation, subscribing to rules, expectations and norms of the LE
  - Emotional: Attitudes towards the learning LE, feelings about engaging

Interest

Individuals psychological state when they engage with particular content, as well as the likelihood of independent and voluntary reengagement with it over time

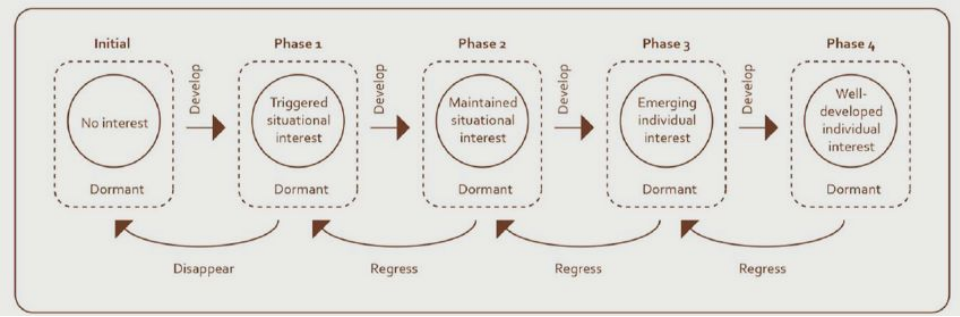


Table 12.1 Learner Characteristics, Feedback Wants, and Feedback Needs in Each of the Four Phases of Interest Development

	Less developed (earlier)		*More developed (later)*	
	PHASE 1 – Triggered SItuational Interest	*PHASE 2 – Maintained SItuational Interest*	*Phase 3 – EMerging Individual Interest*	*PHASE 4 – WELL-DEVELOPED INDIVIDUAL INTEREST*
Learner characteristics	Learners: • Attend to content, if only fleetingly • Need support to engage content: ○ From others (e.g., group work, instructional conversation) ○ Through instructional design (e.g., software) • May experience either positive or negative feelings • May or may not be reflectively aware of the experience.	Learners: • Re-engage content that previously triggered attention • Are supported by others to find connections between their skills, knowledge, and prior experience • Have positive feelings • Are developing knowledge of the content • Are developing a sense of the content's value.	Learners: • Are likely to independently re-engage content • Have curiosity questions that lead them to seek answers • Have positive feelings • Continue developing knowledge and value for what they understand • Are very focused on their own questions • May have little value for the canon of the discipline and most feedback.	Learners: • Independently re-engage content • Have curiosity questions • Self-regulate easily to reframe questions and seek answers • Have positive feelings • Can persevere through frustration and challenge in order to meet goals • Recognize others' contributions to the discipline, as well as the presence of additional information/skills/perspectives to be understood • Actively seek feedback.

Design principles

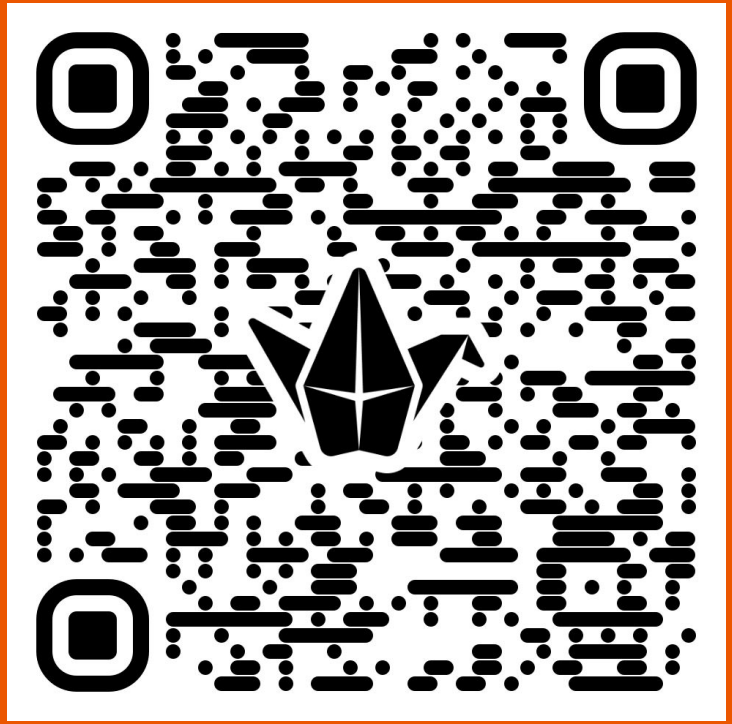
Feedback wants	Learners want: • To have their ideas respected • Others to understand how hard work with this content is • To simply be told how to complete assigned tasks in as few steps as possible.	Learners want: • To have their ideas respected • Concrete suggestions • To be told what to do.	Learners want: • To have their ideas respected • To express their ideas • *Not* to be told to revise present efforts.	Learners want: • To have their ideas respected • Information and feedback • To balance their personal standards with more widely accepted standards in the discipline.
Feedback needs	Learners need: • To feel genuinely appreciated for the efforts they have made • A limited number of concrete suggestions.	Learners need: • To feel genuinely appreciated for the efforts they have made • Support to explore their own ideas.	Learners need: • To feel that their ideas and goals are understood • To feel genuinely appreciated for their efforts • Feedback that enables them to see how their goals can be more effectively met.	Learners need: • To feel that their ideas have been heard and understood • Constructive feedback • Challenge.

1) Work with disciplinary content - language and tasks - begin developing an interest and their abilities
2) Support through scaffolds - peers or design of activities - Different types of interactions and support in different phases of interest development
3) Structure of tasks and learning environments must be adapted for learners in different phases of interest development to focus and challenge

Final Course Reflection

https://forms.gle/tLWDAcDruWbw3CFt9

Think-pair-share: One person analyse case 1 and one analyse case 2 individually. Identify instances of motivation and engagement, and developing interest. Then share your case analysis with your partner. Critique your partners analysis. Share with the class.



Case Study 1

Maya and Imara's journey in the competition to win the six-week invention program begins with a desire to address a big problem such as women's safety through their invention. Facilitators speaking about their own difficulties influence the problem direction in which they move. Their user-centered design process involves exploring existing solutions and building empathy for the user. Peer feedback challenges their innovation's novelty making them question their own work. However facilitator feedback gives them confidence in their own idea and they continue prototyping, persisting in experimenting and refining their prototype despite issues in its working. They also show diligence in writing their pitches, taking facilitator feedback and adapting their communication style. The growth is evident in improved communication and professionalism, and they win the first prize program. Both participants express an intention to continue their innovation trajectory.

Case Study 2

Sharat and Vijay entered the invention factory program with diverse motivations. One of them wanted to stay on campus for the summer, while the other applied because of peer pressure but did not expect to get it. Their problem shifts from water rescue because they did not believe they could design a solution for it, to protecting juice makers' hands. Challenges arise right from ideation and continue into solution development, specifically due to the interplay of ineffective pitching and lack of scripting. The disagreement in perspectives and commitment of each of the partners hinders progress in their solution development. Peers further questioning their idea leads to increased effort from Sharat, in contrast to Vijay's disillusionment and lack of confidence. Facilitators guide them, but an undercurrent of disapproval owing to Vijay’s past actions also creates stress. They do not take facilitator feedback into consideration in improving their pitches leading to poor performance during the pitching sessions. Neither Sharat nor Vijay showed a desire to continue innovating or making things to address problems.

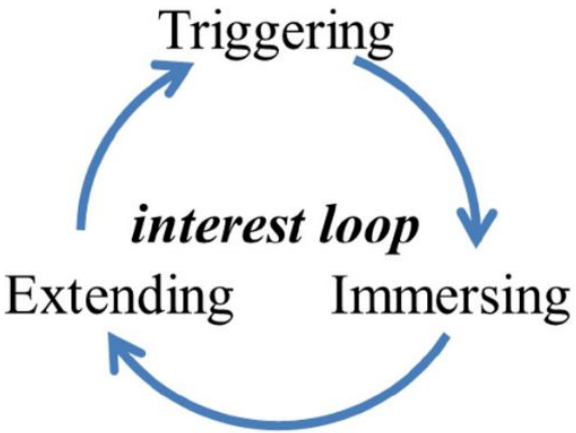
Student Responses

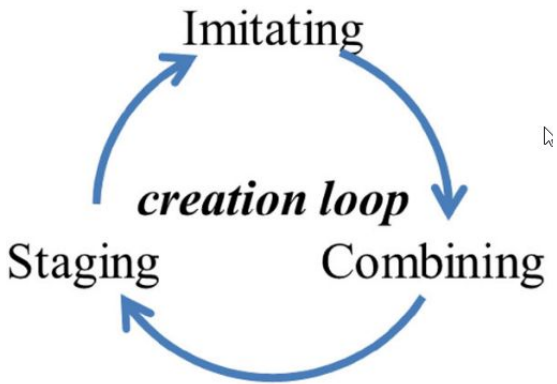
Interest-Driven Creation

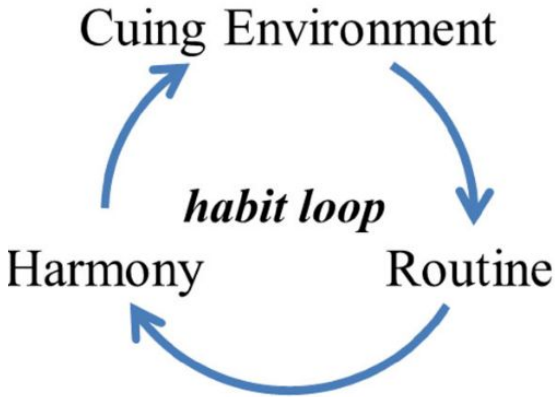
- Proposed as a macro-design theory to override the examination-culture and prepare students for 21st century competencies such as innovation by increasing their interest
- Assumption: Learning is a process composed of interest, creation and habit
  - Interest leads to enjoyment and increases effectiveness
  - Creation makes it productive and gives sense of achievement
  - Habit makes them interest-driven creators capable of self-directed behaviours
- Design - consider at individual or group level:
  - Tune to individual interests (contextualize)
  - Make learning activities creation activities
  - Incorporate creation activities into daily routine

Interest-Driven Creation

- Learners are expected to enjoy, want to learn, excel in learning and exams, develop competencies and their potential
- Component concepts of main concepts: first and second level consideration for design design

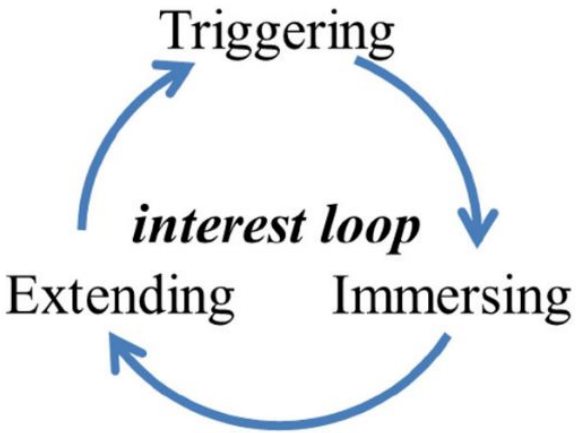






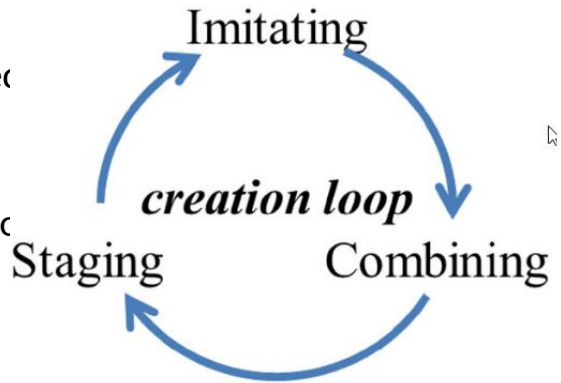
Interest loop

- Triggering interest - curiosity - information gap
  - Anticipated but unknown outcome
  - Violating expectations, which motivates a search for an explanation.
- Immersing interest - flow - immersion in learning - focus and energy
  - Clear goals
  - Immediate feedback
  - Balance between challenge and skill
- Extending interest - meaningfulness - use what they have learned/ lear integrate knowledge from diverse disciplines
  - Relating and integrating newly encountered knowledge with prior knowled
  - Students perception of relevance to their authentic daily lives

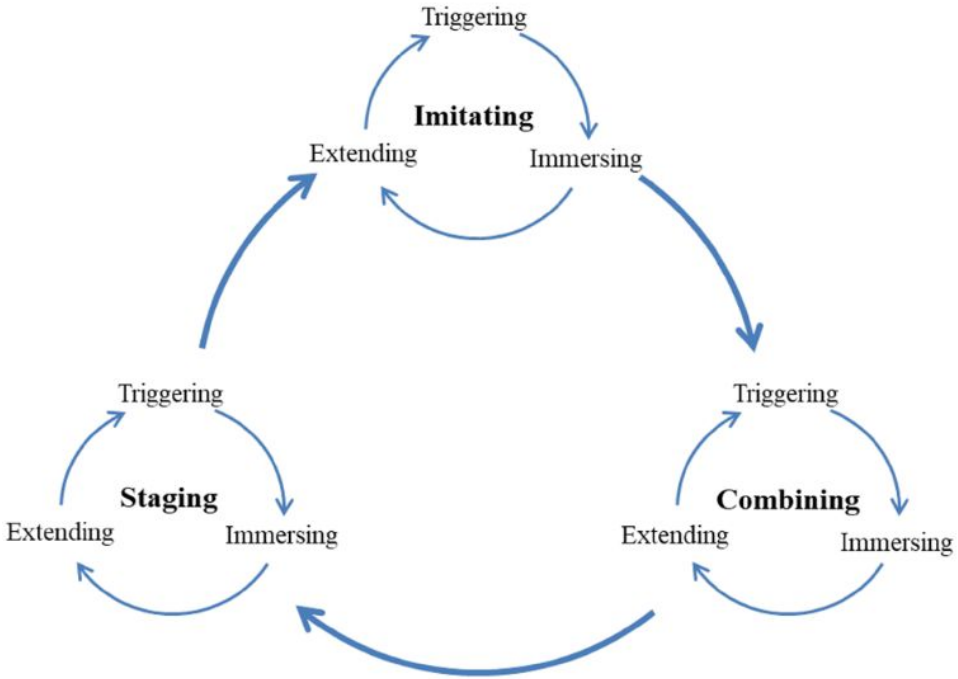


Creation Loop

- Imitating - Observing and reproducing to create and gain knowle artefacts
  - Similar to modeling
- Combining - Generating new artefacts or knowledge or ideas thro integrating existing knowledge and artefacts and own ideas
- Staging - Reveal, describe and demonstrate artefacts to peer
  - Receiving and giving feedback
  - Sense of achievement and ownership, self-efficacy



Anatomy of an interest-driven creation activity



Making interest-driven creation a habit

- Cueing the environment - habit triggers or signals
  - Consistent cueing environment/ arrangement of environmental cues will lea
- Routine - as in other routine activities of school
- Harmony - sense of satisfaction
- Importance of context
  - Crucial to foster interest
  - Crucial for meaningful creation activities
  - Crucial for cueing habits