3 Challenges for any Adjustments of Instruction, as with using Design Method:
- flexible? (to accomodate a wide range of learning & teaching styles);
- easy to learn (so extra preparation-time is low) + immediate high quality of teaching;
- with limited time for instruction, teaching of skills can decrease a teaching of ideas.

Teaching Design Method using Computer Programs can help with all 3 challenges:
- flexibility (more options, so students' work can be computer + individual + group);
- program can teach basics of Design Method, thus reducing teacher-workload;
- if programs are done as homework, this doesn't compete for limited class time.

Education for Thinking Skills & Thinking Methods

My integrative models have **two main goals** , to
A — accurately describe the methods used in design & science, thus improving our **UNDERSTANDING**,
B — help students improve their thinking skills & methods, thus improving our **TEACHING** .

I think "**A**" has been achieved, and "**B**" shows promise for:

• **achieving a worthy goal:** We should help students improve their creative-and-critical thinking skills/methods; teaching the methods used in design & science can help us achieve this goal.

• **a wide spiral curriculum** — by using Design Method in a curriculum [mainly K-12?] with **wide scope** (to coordinate diverse subject areas) and **spiral repetitions** (coordination over time). This can help students understand the integration of thinking skills **within** each design experience, and **between** experiences in different areas, for better transfer and for synergistic support between areas.

TRANSFER (from **Life** to **Design** to **Science** to **Life**) is increased by:
- **using ideas many times in different contexts & at different levels**, as in a Wide Spiral Curriculum with wide scope (across many areas) and with spiral repetitions (across time); Design Method is used for almost all we do.
- **teaching ideas in general abstract form**, not domain-lingo; Design Method is generalized: Define, Generate, Evaluate, Coordinate; Predict, Observe,...
- **Learning from the Past** (reaching back); ask "what have I learned in the past that will help me now?" (do self-guidance by prompting memory, giving hints)
- **Learning for the Future** (looking forward); ask "what can I learn now that will help me in the future"; **intentionally learn** for retention-and-transfer ; develop **Conditional Knowledge** (about when to use each skill, and why), then match situation (what things need doing) with capability (how to do things).

Learning from Experience — Each time you do a job, do it better than before; always concentrate on quality now, sometimes search past & learn for future; goals can be for optimal current performance and/or learning for the future.

- We should teach **Design before Science**: Our designing (of products, activities, strategies, theories) is most of what we do in life, thus:
- diverse areas use design, so (as in "transitive math") we can use Design Method to connect areas in a **wide** spiral curriculum.
- students have used design; it's already in **their past experience** (so we can build on what they know), can be in **their future plans** (so they are motivated to learn skills that will help them achieve their personal goals for life). Therefore, especially in K-12, we should **teach design before science**, and design method before scientific method. Then we build bridges from design to science because reality checks (the foundation of science) are also used in design; and when students know Design Method they already know all of the main skills in Scientific Method, because Science is just a special type of Design in which the main objectives are accurate theories and useful experiments.

Eclectic Instruction: not "if some is good, more is better, all would be best"; instead combine the best features of each approach, with goal of producing "the greatest good for the greatest number of students" for ideas-and-skills.

for Ideas (Conceptual Knowledge), I think the best approach is combining Explanation-Based Instruction with Activities for Application & Extension.

for Skills (Procedural Knowledge), use Inquiry Activities (design-inquiry and science-inquiry) along with explicit teaching of problem-solving strategies that are general (using Design Method) and domain-specific.

• **improving student motivation:** ideal is Educational Teamwork with an "us" feeling; this requires goal-directed teaching (by us) plus goal-directed learning (by students), with a we-and-they matching of goals. How to match? • We can adjust to student-ideas of what is fun now or will be useful later (to achieve their personal goals for life), and • we can persuade students to change their motives, so our teaching-goals become their learning-goals. How?

Words /Actions, Intentions / Competence: Using **words** (what we say) and **actions** (what we do) we can persuade students of our good **intentions** (we are "on their side") and **competence** (to define worthy goals, and help students achieve these goals). We can try to persuade students that what they are learning is fun now and will be personally useful in their future.

Components of Total Motivation: intrinsic (enjoy interesting activity), personal (learn ideas-and-skills to improve quality of life, now or later), interpersonal (impress others), external (perform well to get good grades). All components of motivation are **internal** because all contribute to how a person thinks about what they want in their whole life as a whole person.