Chapter 9

Simulation Approach to Instruction

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Editors' Foreword

Preconditions

Content

- Integrated skills that consist of multiple complex actions in a fluid sequence and changing circumstances

Learners

- All learners

Learning environments

- Environments that have the appropriate tools (computers or other materials)
- Instructional simulations or microworlds must have augmentations

Instructional development constraints

- Simulation or microworld cost must not exceed either available resources (money and time) or benefits

Values

about ends (learning goals)

- Understand principles and relationships in dynamic systems
- Developing skills for dealing with complex systems

about priorities (criteria for successful instruction)

- Effectiveness, efficiency, and appeal can all be maximized, as long as the user population is large enough to make it economical.

about means (instructional methods)

- The learning experience should be adaptive, generative, and scalable.
- The learning experience should involve authentic tasks and contexts.
- The learning experience should involve a dynamic model of physical and/or conceptual systems.
- Learner interactions with the model should result in state changes.
- The learning experience should have at least one designed augmenting instructional function.

about power (to make decisions about the previous three)

- Learners are active participants who have some degree of free agency within the simulated environment.

Universal Methods

1. for the content function

- Create an abstract model first, then a computerized model.
- Select the "right" model.
- Select the appropriate type(s) of models (environment, cause-effect, or performance model).
- Select the appropriate forms of models (semantic networks, production rules, equations, Bayesian networks, system dynamics, or object models).
- Make a limited number of control points available to learners for manipulation of the system.
- Align the different kinds of fidelity and resolution of the model with the learning needs, inasmuch as costs allow.
- Escalate performance difficulty by supplying progressions of advanced models, advanced problems, or both.

2. for the strategy function (instructional augmentations)

- Design the physical setting and siting.

- Design the social settings (participant roles and patterns of initiative-sharing).
- Describe the properties of models and the range of performances that encompass subject-matter goals, problem solving goals, and learning-to-learn goals within each model.
- Assign instructional scopes (goals) to event blocks and arrange them into sequences (progressions).
- Specify event forms and classes.
- Design augmentation types and rules.
- Use a dramatic context.
- Design the means of supplying problem-related information to learners.

3. for the control function

- Provide user controls for each main function.

4. for the messaging function

- Generate message units that have certain elements of a human tutor.
- Use approaches for structuring messages.
- Use execution-time construction of messages.

5. for the representation function

- Generate and assemble representation elements.
- Change model states according to the cycles of the model.
- Consider giving the learner alternative vantage points.
- Decide what representations a single message should be given.
- Design rules for the execution of the continuously-changing displays.
- Design rules for manipulating time and space.
- Design traces that represent trends of change.

6. for the media-logic function

- Execute representations and computations.

7. for the data management function

- Manage data resulting from interactions.
- Design data collection points and variables.
- Decide on interpretation variables and rules.
- Design a data-gathering framework.
- Decide on points at which to give information to the learner.

- CMR & AAC