LINKAGE Multimedia Software

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As part of the Synthesis Coalition work at Stanford, we embarked on a research project to determine whether alternative media could improve learning. Specifically, we designed a multimedia courseware module which was intended to enhance engineering students' grasp of the intuitive concepts of mechanical linkages. The courseware was an integral part of a two-week segment of the curriculum of a mechanical systems course. Through the addition of multimedia we hoped to effectively involve students in steps of the learning cycle which are negelected by traditional lecture-and-problem-set formats. Ten students were videotaped using the courseware during three different homework assignments. The tapes of the first session have been analyzed using a method called Video Interaction Analysis (VIA). The VIA sessions yielded some detailed and rich discussion about the use of the courseware. Anonymous student questionnaires confirmed many of the preliminary conclusions that were drawn from the VIA. We found that use of multimedia can indeed improve the construction of new intuitive models by involving additional learning modes in the curriculum.

Below are summarized the results from roughly 65 student questionnaires of seniors using the multimedia courseware that we have developed on linkages. The students used the courseware in a course on elements of machine design during the winter quarter of 1995. Answers or results are shown in blue italic text.

1) Which problem did you and a partner complete on homework #2?
      Problem 2A - Toggle Clamp *(60% of the class)*
      Problem 2B - Desk Lamp *(40% of the class)*

2) On a scale of 1 (least) to 5 (most), how interesting was the multimedia linkage courseware, overall?
      •4.16 •

3) On a scale of 1 (least) to 5 (most), how much did you learn by using the multimedia linkage courseware versus other ways of presenting the material?
      •3.92 •

4) What did you learn by reviewing Chapter 1 and the Examples?

    • Basics of kinematics, linkages, etc.

    • How the dynamics of different linkage systems played out.

    • How a 4-bar works, the various parts to one. How some of the stuff we use uses stuff we learn in ME112.

    • It solidified things we were studying in class. I also concentrated more because it was something I could go back to again and again if I forgot what different types of linkages looked like.

    • I got more a an intuitive feel for what linkages are and how they move and work.

    • Not as much as I would have hoped. I still feel that the best way to learn is by doing.

• the basic rules of linkages (Gruebler's formula, -1 for an overconstrained linkage, 0 for a structure, 1 for a four-bar, etc.)

• Probably learned the most about the behavior of different linkages, what makes them rotate vs. oscillate, follow a path, stay pointed on one angle...

• Not much, since I didn't really read Chapter 1.

• about linkages -- cool examples

• I guess not much, because I can't really remember what was in chapter one.

• general terms/definitions and overview of linkages.

• no new concepts to learn, just clarified by visual aids.

• clarified the degrees of freedom and got to see them in action

• In the stack? Um, the types of motion that are possibile...complexx number loop equations - though I don't feel solid on that stuff.

• I think the most valuable thing learned was in obeserving the examples in motion.

5) What do you feel made or would make the multimedia presentation of linkage design better or worse than a typical textbook presentation?
       • Most respondents answered 'movies' •

6) On a scale of 1 (worst) to 5 (best), rate the following items:

a) Video quality of Quicktime movies
       (the small windows that you could opento "play" a linkage)   *•4.14 •*
b) Effectiveness of Quicktime movies in conveying useful information   *•4.80 •*
c) Quality of still images/pictures and diagrams   *•4.32 •*
d) Ease of navigation through the courseware   *•3.46 •*

7) Did you generally watch the movie or read the text first?

8) Did you sometimes read the text and watch the movie at the same time?

9) On a scale of 1 (much less) to 5 (much more), would you like to see more or less of the following items in the courseware?

       a) TEXT   *•3.04 •*
       b) SOUND   *•2.83 •*
       c) PHOTOS   *•3.74 •*
       d) DRAWINGS   *•3.87 •*
       e) EQUATIONS   *•3.39 •*
       f) MOVIES   *•3.98 •*
       g) ENGINEERING THEORY   *•3.80 •*

13) What are the weakest points or parts of the Courseware?
       •44% of respondents mentioned something about NAVIGATION difficulties •

14) What are the strongest points or parts of the Courseware?

• 84% mentioned something about gaining INTUITION about linkages •

15) What was your favorite part or section of the Linkage Courseware?
    • Most people answered the movies, or the examples (especially palm tree sprinkler). •