Modality and placement of a pedagogical adviser in individual interactive learning

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Abstract
Fifty-eight graduate students in an education programme took a 40-minute computer-based instructional module on introductory statistics with a built-in solicited guidance mechanism. Students were randomly assigned to programs that used one of four types of advisement: on-screen digitised video of a human adviser, on-screen text-based adviser, pull-down digitised video of a human adviser or pull-down text-based adviser. Results indicated that the on-screen video-based adviser condition resulted in higher adviser use than both the text-based and video-based pull-down adviser conditions. Adviser use was significantly correlated with performance during instruction, with time spent during instruction and with television hours watched per week, but not with retention scores. Two non-significant but suggestive findings were that the video-based on-screen advisers were used twice as much as text-based on-screen advisers, and active learners used advisement three times as often as passive learners.

Introduction
One of the more interesting practical questions involving the use of new media for instructional purposes concerns the best way to ‘coach’ a student who needs additional help in understanding complex concepts. It is suggested by some researchers (eg, Smith, 1992) that this coaching (or advisement) acts as an intermediate point between generative and supplantive instruction. This study investigated the use of an online adviser to assist students in learning statistical concepts via computer-based instruction. The use of advisement in computer-mediated lessons has been well supported since micro-computers first came into use (Santiago and Okey, 1992). Studies by Tennyson and his associates (Johansen and Tennyson, 1983; Tennyson, 1980, 1981; Tennyson and Buttrey, 1980) found that designing computer-based lessons using learner control with advisement increased performance when compared to lessons designed with either adaptive (program) control or learner control without advisement. In most cases, per-
formance increase was accompanied by a decrease in total instructional time compared to adaptive control methods (Gray, 1988; Tennyson, 1980, 1981). Although some advisement strategies have been shown to be effective, getting students to use advisement has been problematic. Gay and her colleagues, for example, presented data that a text-based, online adviser was not used very often (Gay and Mazur, 1993). In the sense that an adviser ‘cues’ the learner regarding important issues during instruction, placement and ease of use of the adviser are important concerns, particularly with more passive learners (Lee and Lehman, 1993).

The limited numbers of interactive learning environments that employ an adviser or coach frequently present the information in text. With more recent technological advances in software and hardware, audio and video advisers have become viable alternatives to text. Although there are bandwidth-related problems in using audio and video on the Internet, there is every reason to suspect that these barriers to using rich media will not be long lasting. Research concerning the use of video and audio advisers, however, has been limited or has had limited generalisability (see, eg, Austin, 1994). Even so, a video adviser in the form of a ‘talking head’ has been applied quite cleverly in certain computer-based training programs. For example, Red Hill Studios’ Shoot Video Like a Pro (1995) provides talking head ‘experts’ to supply learners with tips to improve their emerging skills. The experts in this software are built into the camera-like interface, are both male and female and come from a variety of ethnic backgrounds.

Theoretical background

Programs using video coaches fit well into a model for human-computer interaction proposed by Streitz (1988). In Streitz’s model the learner is confronted with an interaction problem that requires the learner, as a user, to build a representation of the tutoring system. In addition to the ‘learner’ and the ‘system’, the model proposes a problem mediator and a human tutor. The human tutor reflects the fact that a person often does not learn strictly on his or her own initiative but because a person (boss, teacher, friend, etc.) proposes a learning path. According to Streitz this person functions as a problem mediator who makes suggestions or asks questions about specific content domains.

Educational research and theory regarding the use of video in computer-based environments is still in an early stage and, as with many other topics, the literature is inconclusive. In a study of inferencing strategies used by fifth-grade students, Neuman (1992) found that both text and video elicited similar inferencing strategies. Conversely, Simonson et al (1985) found that realistic messages, such as those in video images, have a positive effect on learner attitudes in the direction of the intended message. In a study comparing the effectiveness of textual feedback to video feedback in a technology-based biology lesson, Lalley (1998) found that video feedback resulted in superior learning and retention. Moreover, students preferred video over text as a feedback modality. A study by Barba and Armstrong (1992) suggested that low verbal students instructed
with interactive video performed statistically better than low verbal students not instructed with the interactive video component. A more recent study by Van Eck and Dempsey (2002) found that participants using contextualised video advisers in a non-competitive context had increased learning transfer. Kosma (1991), however, cautions that novices are more likely to fail at comprehending portions of video because their pace of processing information may be slower than the pace of the presentation of the video information.

Additional research in employing human or human-like pedagogical advisement comes from the literature concerned with animated pedagogical agents (Clarebout et al, 2002). From this perspective, the video adviser would function in the instructional agent role of ‘coach’ by providing hints and feedback which help to activate the learner performing a task or learning a skill. This literature is relatively inconclusive in terms of determining when the benefits of using human-like pedagogical agents is worth the cost of development (Moreno, 2001). In general Baylor (2002) and Dehn and van Mulken (2000) contend that using pedagogical agents does not significantly improve retention. Research by Moreno et al (2001) did find limited retention effects under certain circumstances as well as improvements on transfer tests and interest ratings.

As Moreno (2001) has discussed, a primary theoretical argument for including highly visible agents (be they animations or video characters) is based on interest theory of learning (Dewey, 1913). The application of this well-travelled theory suggests that students will react more favourably to computer programs that include social cues such as facial expressions and human voices and thus learn better. Another recent study on this topic by Baylor (2002) provides some limited evidence that pedagogical agents can facilitate the promotion of metacognitive awareness.

Will learners actively seek out information required for knowledge or skill development? A science-related study using undergraduates conducted by Lee and Lehman (1993) found that instructional cues (hints to view embedded information) proved beneficial to participants classified as passive learners and those classified as neutral (neither active nor passive). Active learners, by contrast, were unaffected by unsolicited instructional cues. Lee and Lehman also found that passive and neutral undergraduate learners who used the hypermedia program with instructional cues performed better than their counterparts who used the program without cues.

Given the assumption that an adviser is beneficial, where should it be located? At least for Western cultures, research in both page design and screen design generally concurs that the left half of the screen or page has a strong influence on reader attention (Duin, 1988; Niekamp, 1981). Left placement has also been found to speed retrieval and improve readability (Hartley and Burnhill, 1976). It would make sense, therefore, to place an adviser (of whatever modality) on the left side of the screen to maximise its effectiveness. At the same time, most researchers and interface designers agree that a computer screen should be less crowded than even its printed counterpart. Past research findings have maintained that text legibility is reduced on computer screens.
compared to printed materials (Kruk and Muter, 1984; Reubens and Krull, 1985).
Although some of these findings may have been confounded by comparing low-
resolution displays to high-quality print (Bender et al., 1987; Oborne and Holton,
1988), the dynamic nature of computer materials unquestionably imposes additional
needs for parts of the screen to be dedicated to non-content materials (eg, navigation
bars). In other words, space is at a premium in computer-based materials.

Commercial applications software has responded overwhelmingly to the inherent space
limitations of computer screens by the use of pull-down menus and commands. User-
controlled menu bars are present in literally thousands of applications including those
used most commonly such as word-processing programs. Educational research on the
use of pull-down menus, however, is limited. One study by Schuerman and Peck (1991)
suggests that the use of pull-down menus does not encourage learners to randomly
access instructional components. Bolton and Peck (1991) found that learners, when
presented with a single content screen, have a strong tendency to select items in the
order listed in the menu.

**Research design**
The purpose of this study was to explore the use of advisement and the modality of the
advisement mechanism in a computer-based, interactive learning module. Independent
variables were the placement of the adviser (pull-down menu access to the adviser vs
an on-screen access) and the modality of the adviser (digitised video of a human adviser
vs a text-based adviser).

Dependent variables were (a) the number of times the learner chose to use the adviser,
(b) delayed posttest scores, (c) performance on practice items during instruction and (d)
motivation indices based on Keller’s ARCS model (1987a). Because computer anxiety
and prior experience using computers have been shown to be correlated (Chua et al,
1999; Chu and Spires, 1991), students’ scores on the Computer Anxiety Ratings Scale
(Heinssen et al; 1987; Miller and Rainer, 1995) were used as a covariate. Time spent in
instruction and learning style based on Lee and Lehman’s Passive Active Learning
Scale, or PALS, (1993) were collected for planned post hoc comparisons.

Our expectations were:

1. The on-screen conditions would result in more frequent adviser use than the pull-
down conditions.
2. The video adviser would be used more frequently than the text adviser.
3. Using an adviser would be positively correlated with performance during instruc-
tion and on the posttest.
4. Learners who were classified as ‘passive’ on the PALS instrument would use advise-
ment less than those classified as ‘active’ in the pull-down conditions, but that this
difference would decrease or be eliminated in the on-screen conditions.
5. The use of an adviser would lead to higher motivation indices in general and video
advisement in particular would result in higher motivation indices than text.
Method
Participants
Participants were 43 females and 15 males aged 21 through 57 years, with an average age of 35. Participants were drawn from three graduate educational research survey courses and one graduate course in psychological principles of learning at a southeastern university. Participation was voluntary, no extra credit or incentives were provided for participation and performance was not tied to course grades. The instructors were not aware of how individual students performed during the instructional module. No students elected not to participate, although absences during one or more of the days involved, program or hardware errors and other factors contributed to mortality. Participants had attended an average of 3.2 computer-related classes, had 4.9 years of computer experience and watched television 11.3 hours per week. Participants were randomly assigned to one of the four experimental conditions.

Materials and instruments
A 40-minute instructional module on statistics was developed using Macromedia Authorware. The interactive multimedia lesson covered sampling distributions, hypothesis testing, and type I and II errors. The participants in all conditions were given detailed instructions in the beginning of the module on how to navigate through and use the instruction and the adviser. The instruction employed a ‘rule-example-practise’ format, and incorporated colour, graphics, text, sound and feedback. Participants were presented with an orientation and instructions screen that described the purpose of the module, the means of navigation, and where advisement was located and could be accessed. To ensure participants were able to select advisement, a practise opportunity was provided. No participant could begin the lesson without successfully selecting and viewing this advisement example. Based on the participant’s assignment, advisement for each of the 25 practise items during the instruction was available either in video or text format, and could be accessed by clicking on a 3 × 2 inch purple square in the lower left corner of the screen labelled ‘Click Here For [Text or Video] Adviser’ (the video on-screen conditions) or via a pull-down menu labelled either video adviser or text adviser (the pull-down conditions). Participants were provided with introductory screens and objectives for each section of the module: Sampling and Population Distributions, Use of Sampling Distribution Logic in Research, Null-Hypothesis Testing Logic and Type I & II Errors. In general participants were provided with instructional text accompanied by audio, followed by at least one example and one practise item. During practise items, participants were asked a question based on the rule or concept just covered. Participants responded by typing in text, clicking a button or word or dragging an item to a location on the screen. Answers were evaluated and feedback (knowledge of correct response) was provided immediately. Participants were able to navigate forward or backward as many screens as they wished at all times.

The software program was designed by two doctoral students in instructional design under the supervision of an instructional design professor. The program was reviewed for content accuracy by two experienced educational researchers and was formatively evaluated during two pilot studies.
The computer program tracked student performance, time and adviser use during instruction. An 18-item delayed posttest was constructed based on the content objectives for the statistical module. A 36-item motivation instrument was a modification of Keller’s Instructional Motivational Scale (Keller, 1987b). This scale includes statements related to attention, relevance, confidence and satisfaction specifically oriented toward instructional computer programs. The 7-item Computer Anxiety Rating Scale (CARS), developed by Miller and Rainer (1995) from the original 19-item scale developed by Heinssen et al (1987), measured computer anxiety. This scale has been shown to reliably measure high and low anxiety constructs, with Cronbach alpha scores of .82 and .73 respectively. The 31-item Likert type Passive Active Learning Scale (PALS) developed by Lee and Lehman (1993) measured Passive/Active learning style. This scale has been shown to reliably measure the passive/active-learning construct, with a Cronbach alpha score of .81. The posttest was an 18-item multiple-choice instrument, with a Cronbach alpha score of .68 and a Guttman split-half reliability of .79.

Procedure
A variety of demographic data including age, gender, computer classes attended, computer experience and graduate classes taken were collected prior to the instruction. At the same time participants completed the CARS anxiety measure. Participants were randomly assigned to one of two levels of each independent variable: on-screen video, pull-down video, on-screen text or pull-down text. All participants were seated at their own computer in a computer lab and issued a set of headphones for listening to the audio portions of the instruction. Participants proceeded at their own pace through the instruction. Immediately after completing the instructional module they completed the ARCS-based attitude-toward-instruction instrument. Exactly one week later the PALS instrument and the posttest were administered to the participants in their normal classroom at the beginning of class prior to study of the material covered in the instructional module.

Results
Hypothesis 1: Participants in the on-screen conditions would select advisement more than participants in the pull-down conditions (main effect for placement).

This hypothesis was partially supported. A one-way ANOVA indicated significant differences in adviser use between groups ($F = 3.385, P = .025$). Because Levene’s test for equality of variance was significant, estimated marginal means, which are not affected by unequal variances, were used for post hoc analysis. In general a main effect for on-screen advisement was found, with video-based advisement resulting in more frequent adviser selection than the other conditions. The video-based on-screen advisement condition resulted in higher adviser use ($M = 5.25, SD = 6.12$) than both the text-based ($M = .866, SD = 3.09$) and video-based ($M = 1.00, SD = 2.08$) pull-down adviser conditions. Although text-based on-screen advisement ($M = 2.38, SD = 2.08$) was selected more than twice as often as either of the pull-down conditions, the differences were not statistically significant.

Because it was hypothesised that text-based advisement and pull-down advisement would result in little or no adviser use, and because adviser use has a low base rate to begin with (ie, people do not seek or use advisement frequently), analysis by inferential statistics is limited. Thirty-five, or 60\% of all participants, did not use the adviser at all, resulting in a high number of zeros in the advisement use variable. The majority of these zero scores were in the pull-down and text-based conditions, making the variable positively skewed and bimodal. There are no transformations available for a variable with this many zeros. This makes it hard to detect a difference using inferential statistics without extremely large sample sizes. Non-parametric statistics, which are not affected by skewed variables, yielded identical results, and for the same reasons.

Also due to the large number of zeros, the adviser use variable was converted to a categorical variable and investigated by chi-square analysis. Thirty-five scores of zero were recoded as ‘none’ for adviser use. The remaining 23 fell between 1 and 7, and 12 and 17. These scores were recoded as ‘some’ adviser use. A chi-square analysis was then run with condition and the new adviser use variable, and yielded similar results to the ANOVA. Because values between 1 and 17 were collapsed, important variance may be obscured.

Hypothesis 2: Participants in the video-based adviser conditions would select advisement more often than participants in the text-based adviser conditions (main effect for modality).

This hypothesis was not supported. Although video-based on-screen advisement differed significantly from text-based pull-down advisement, it did not differ significantly from text-based on-screen advisement, nor did video-based pull-down advisement differ significantly from text-based pull-down advisement.

Hypothesis 3: Adviser use would result in higher scores on performance during instruction and on the posttest (correlation).

This hypothesis was partially supported. Pearson Product Moment Correlations indicated that adviser use was significantly related to performance during instruction (\(r = .407, P < .01\)), but not to performance on the delayed posttest (\(r = -.049, P > .05\)).

Hypothesis 4: Learners who were classified as ‘passive’ on the PALS instrument would use advisement less than those classified as ‘active’ in the pull-down conditions, but this difference would decrease or be eliminated in the on-screen conditions (interaction).

Active learners were defined as learners who scored one standard deviation above the mean PALS score; passive learners were defined as learners who scored one standard deviation below the mean.

A 3 × 4 ANOVA of passive/active/neutral learner by condition on adviser use indicated no significant differences probably due to the large number of zeros. This hypothesis was not supported. A one-way ANCOVA with anxiety as a covariate yielded
identical results as the ANOVA. Even so, the descriptive statistics show an interesting pattern.

Active learners (M = 2.55, SD = 5.05) and neutral learners (M = 3.23, SD = 5.19) used advisement about three times as often as passive learners (M = .85, SD = 2.07).

Active learners in the video on-screen condition (M = 4.66, SD 6.57) used advisement three times more often than active learners in the text on-screen condition (M = 1.50, SD = 2.12) and 28 times more often than active learners in the text pull-down condition (M=1.5, SD = 2.12). Active learners in the video pull-down condition did not select advisement.

Passive learners in the video on-screen condition (M = 5.5, SD = 2.12) used advisement 16 times more often than passive learners in the text on-screen condition (M = .33, SD = .57). Passive learners in both of the pull-down conditions never selected advisement.

Neutral learners in the video on-screen condition (M = 6.20, SD = 7.15) used advisement almost twice as often as neutral learners in the text on-screen condition (M = 3.37, 5.90), 3.5 times as often as neutral learners in the video pull-down condition (M = 1.75, SD = 2.54), and 2.5 times as often as those in the text pull-down condition (M = 2.40, SD = 5.36).

Hypothesis 5: The use of an adviser would lead to higher motivation indices in general and video advisement in particular would result in higher motivation indices than text (main effect for adviser use on motivation).

This hypothesis was not supported. One-way ANOVAs and ANCOVAs failed to yield significant differences between groups for the ARCS motivation scale. Factor analysis of the ARCS scale failed to yield any meaningful factors.

Again, because of the nature of the adviser use variable, inferential statistics are not likely to detect differences. Therefore, it may be more appropriate to look at descriptive statistics. Thirteen, or 37% of those who never selected advisement, were in the text pull-down condition. Eleven, or 31%, were in the video pull-down condition; seven, or 20%, were in the text on-screen condition; and four, or 11%, were in the video on-screen condition. In total, 68% of all those who never selected advisement were in the pull-down condition. Table 1 summarises this data.

Additional correlations
Anxiety and computer classes were significantly related (.341, P < .05), as were performance during instruction and time spent during instruction (.427, P < 01), and performance during instruction and motivation (.462, P < 01). Performance during instruction was significantly related to posttest scores (.402, P < 01) and to motivation (.27, P < 05). Television hours watched was significantly related to computer experience (.283, P < 05). PALS scores were not significantly related to adviser use.
tions performed between adviser use and PALS scores by condition indicated no significant relationship. A similar analysis of adviser use and television hours watched indicated that the significant correlation found earlier was located specifically in the text obvious condition. Table 2 presents these data in more detail.

Discussion

Advisement performs two important functions according to Hannafin et al. (1996). It can augment or supplant metacognitive processing. As an augmenting function it can be used as a kind of "second opinion". As a supplanting resource it can lessen the cognitive burden associated with self-regulated learning (1996, 387; see also Hannafin et al, 1994). Although other researchers have suggested additional functions (eg, Streitz, 1988), augmenting and supplanting describe well the roles of all the types of advisers used in this study. Of consequence in the discussion of this study is the fact that the learner solicited the advisement when it was used. Where unsolicited advisement is deductive and designer-controlled, solicited advisement is inductive and user-controlled. Thus all the data collected in this study was in a natural context, based on the choices made by users. That 35 of the 58 learners in this study did not use advisement at all comes as no real surprise. It does, however, make inferential analysis of the data a difficult proposition. A colleague of ours likened this study of solicited advisers to an epidemiological study where the zeros are often the most common scores and very large numbers of participants are needed to use inferential statistics effectively. In interpreting the findings of the present study, therefore, we hope that readers will consider the trends conspicuous in the descriptive statistics as well as the outcomes of significance tests.

Our first expectation, that the on-screen conditions would result in more frequent adviser use than the pull-down conditions, was partially supported. Participants who had on-screen access to an adviser used advisement much more than those who had pull-down access to an adviser. Figure 1 shows data that illustrate partial support for the main effect of adviser placement. The on-screen video condition was statistically different from both pull-down conditions. The on-screen text condition, although higher than both pull-down conditions, was not statistically different. The mean adviser

<table>
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<tr>
<th>Condition</th>
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<th>Frequency</th>
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<tbody>
<tr>
<td>Video on-screen</td>
<td>16</td>
<td>12</td>
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<td>Text on-screen</td>
<td>13</td>
<td>6</td>
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Note. * = percentage of all who used advisement at least once, not total percentage; ** = percentage of all who never used advisement, not total percentage.
Table 2: Correlations of variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Perf during inst</th>
<th>Time spent</th>
<th>Anxiety</th>
<th>Comp exp</th>
<th>Comp class</th>
<th>TV hours</th>
<th>Adviser use</th>
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Note: *Correlation is significant at the 0.05 level (2-tailed); **correlation is significant at the 0.01 level (2-tailed).
use for the video-based, on-screen condition, although more than twice that of the text-based, on-screen adviser group, was not significant. This may be partially explained by the high number of zeros in the adviser use variable, the vast majority of which are located in the pull-down conditions. Likewise, our second expectation, that the video adviser would be used more frequently than the text adviser was not supported. Although the mean adviser use for the video conditions was higher than those for the text conditions, the differences were not statistically significant.

One way to view these findings is to consider the video on-screen adviser as that which most closely approximating what Kosma (1994) refers to as a ‘creative interaction’ or Schon (1987) refers to as ‘conversation’ between the designer, the situation, and the medium in which the design both shapes and is shaped by each of these factors. In preparing a solicited adviser, particularly one that focuses on content rather than navigation, the designer is offering to aid the learner, but not dictating that this offer be accepted. One potential benefit of the ‘talking head’ adviser placed strategically on-screen is that the ‘conversation’ with the user is in a more naturally appearing context.

In Isaac Asimov’s famous science fiction Foundation trilogy (1952), the astute Harry Seldon character, a psychohistorian long since dead, uses earlier recorded videos, delivered at predetermined intervals, to proffer advice to future leaders of the Foundation. Naturally Seldon’s advisement caused much interest and speculation among its users.
We have seen this vehicle for advisement used often in our popular culture. Witness the visitations of Obi-Wan Kenobi in Lucas’s *Star Wars* movies. Although introductory statistics is a far less interesting topic than the future of an entire civilisation, it is our interpretation that the on-screen use of the video adviser stimulated more interest than the other conditions and therefore was a better communication tool.

Although all participants were introduced to the mechanics of the method of advisement to which they were assigned, the pull-down conditions unquestionably were ineffective in this study. Approximately four-fifths of the participants in the pull-down conditions never selected advisement. Clearly, the placement of the advisement is consequential. Pull-downs may be omnipresent as functional menus in application programs and online help systems, but the findings of this study suggest that they are less desirable in computer-based training. This finding is consistent with some studies in the human-computer interaction literature that suggest the existence of online help (usually in the form of a pull-down) is a distraction from the task (Relles, 1979; Shneiderman, 1980) and has an adverse effect on user performance, particularly for novices (Dunsmore, 1980; Cohill and Williges, 1982). It also supports Schuerman and Peck’s (1991) finding that pull-down menus does not encourage learners to randomly access instructional components.

Our third expectation, that the use of an adviser will lead to higher motivation indices in general and that video advisement in particular will result in higher motivation indices than text, was not supported. Participants’ motivation scores were in no way associated with their adviser use.

Our fourth expectation, that adviser use would be significantly correlated with performance during instruction and for the delayed posttest, was partially supported (see Table 3). Adviser use was significantly correlated with performance during instruction but not with delayed posttest scores. Because posttest scores and performance during instruction were significantly correlated, the researchers concluded that the tests are reliable. The failure of adviser use to make a difference in delayed posttest scores may say something about the long-term effects of advisement. In other words the advisement may not have been effective enough to make long-term gains significant. Also,

### Table 3: Correlations of adviser use, performance during instruction and posttest scores

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<tr>
<th>Variables</th>
<th>Adviser use</th>
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<tr>
<td>Adviser use</td>
<td>1.000</td>
<td>.407**</td>
<td>−.049</td>
</tr>
<tr>
<td>Perf during inst</td>
<td>.407**</td>
<td>1.000</td>
<td>.402**</td>
</tr>
<tr>
<td>Retention test</td>
<td>−.049</td>
<td>.402**</td>
<td>1.000</td>
</tr>
</tbody>
</table>

*Note. ** Correlation is significant at the 0.01 level (2-tailed).*
because participants were aware that their performance was not graded and that their professor would not know their performance results, participants may not have engaged in any outside rehearsal or practice of the relevant information.

A related finding was that time on-task was correlated with both adviser use and performance during instruction. This finding would suggest that advisement might help learners to engage in more substantive involvement with the instructional materials. From a Vygotskian (1978) perspective this substantive interaction with the adviser or coach is important first of all because the control is in the hands of the individual who has chosen to accept the advisement. Secondly, the designer has an exceptional opportunity to link the learner’s prior knowledge to new knowledge through a simulated social interaction with a ‘knowledgeable other’ (Peters, 1996; Scott et al., 1992). If the adviser is well constructed, the extra time spent in using advisement can become a valuable social and cognitive mechanism for both the learner and the instructional designer.

Finally, we expected that passive learners would use advisement less than active learners, and that this difference would be reduced or eliminated in the on-screen advisement conditions. Although not statistically significant passive learners did use the adviser less in all conditions but the video on-screen condition. Even so the data presented in this study point to the possibility that on-screen video advisers could be effective tools to engage passive learners.

Implications for instructional design and further research

One confident implication of this study is that a pedagogical adviser or agent is used more often when it is built into the interface. The findings of this study clearly suggest that, regardless of modality, hiding an adviser away in pull-down menus is a waste of scarce pedagogical resources. That would appear to be so even when users receive training on using a pull-down adviser as they did in this study. Secondly, although it was not statistically significant in the present study, a video adviser was used more than twice as often as a text-based adviser when the advisers were built into the screen design. That is an interesting trend that deserves to be explored with further research. Although the present study was not able to detect higher motivational indices for learners using video advisement, it is possible that the scale used to measure motivation and interest was simply the wrong instrument to detect these differences.

There was no evidence in this study that advisement alone improved retention. This was not particularly surprising as Baylor (2002) and Dehn and van Mulken (2000) have suggested. Among other dynamics involved, the statistics content used in this study was difficult and probably required multiple exposures before long-term retention was affected. Even so performance during instruction was significantly correlated with solicited (voluntary) adviser use in this study. That is a promising finding. It suggests that the advisement helped learners study new content and offers encouragement for continued research on pedagogical advisers and agents.

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