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Article Critique

Affordances of mobile technologies for experiential learning: the interplay of technology and pedagogical practices.

Lai, C., Yang, J., Chen, F., Ho, C., Chan, T. (2007). Affordances of mobile technologies for experiential learning: the interplay of technology and pedagogical practices. *Journal of Computer Assisted Learning*, 23, 326–337.

Theoretical Perspective

The purpose of this study was to determine how utilizing mobile technology systems would facilitate experiential learning. Research on the use of PDAs for educational functions addresses an important area that deserves further study. This research can inform our understanding of important topics such as the effectiveness of mobile devices in education and how to best introduce them in regard to learning flow. This study has merit, however, in its current form it has limitations that raise questions regarding its usefulness.

The study begins by laying a theoretical framework from which it attempts to build upon. One of the lynchpins of the framework is the concept of affordances (hence the reason it is the first word of the title). Having carefully studied James Gibson's ecological approach to perception for many years, I feel qualified to comment on the use of the term affordances which is liberally used in this paper. Furthermore, I think it is

important to briefly outline what using terminology from this perspective implies. Perception is messy, in that sensory data that arrives in our visual cortex is two dimensional, inverted, and distorted and Gibson was concerned about the epistemological problems that arise by assuming the brain does “information processing” to piece this welter of data back together. Gibson asked how can we develop awareness (intelligence) of the world through perception, when the only way for perception to work, according to the information processing view, is to presuppose that very intelligence. To avoid this circular reasoning Gibson proposed the concept of affordances, which takes the complexity of sensory data from the organism and moves it to the environment. In this model, organisms do not detect a jumble of distorted sensory data, but they detect meaning. Gibson notes, “[t]he affordances of the environment are what it *offers* animals, what it *provides* or *furnishes*, either for good or ill.” So for Gibson, we do not perceive chairs, pens, or bagels, but places to sit, objects with which to write, and things to eat.

Paul Kirschner used Gibson’s model with his concept of educational affordances. Instead of perceiving an object in and of itself, we perceive a learning behavior to be enacted. For example, instead of perceiving books we perceive things to read. Thus, using the approach of educational affordances, the artifacts of the environment become crucial. In other words, does the environment fulfill the learning intentions of the learner? In the article *Designing Environments for Collaborative E-Learning*, Kirschner, Strijbos, Kreijns, and Beers state, “once a learning need becomes salient, the educational affordance of the device or of a learning environment will not only invite but will also guide a member to make use of a learning intervention to satisfy that need.”

There is plenty of exciting research that can be done with educational affordances, but this paper has only a tenuous connection to the concept that leaves me wondering why the authors bothered. For example, to simply state, “mobile technologies ‘afford’ real-time information” or “mobile technologies ‘afford’ rapid access interface” sounds impressive, but when the concepts are understood it is as trivial as saying bagels ‘afford’ eating. For this reason, it is not obvious that the researchers fully understand the concept that is purported to hold so much weight in their research. This transgression may not seem to be overly significant, however, Norman in his article, *Affordance, Conventions, and Design* commented, “Sloppy thinking about concepts and tactics often leads to sloppiness in design. And sloppiness in design translates into confusion for users.” I would recommend reading the article, *Affordances: Clarifying and Evolving a Concept* by McGrenere and Ho which offers ample evidence of how often this concept is misused by researchers and the perils of doing so. In short, this study needlessly ties itself to a perceptual framework that it does not significantly utilize and it only detracts from the research question.

The connections to experiential learning make much more sense. For example, the setting of the experiment was a field trip to a garden where children were to learn about African Touch-me-nots. It clearly utilizes experiential learning, although, for this study both the experimental and the control group make use of experiential learning, so again the large emphasis on this framework was less significant.

The paper attaches itself to these two theoretical concepts: affordances and experiential learning, but how the authors use these concepts to build a theoretical framework to the study was unclear. The best I could surmise was a structure that

looked like this: Experiential learning as described by Dewy, Kolb, and Kaagan is an effective pedagogical strategy although it suffers from two weaknesses: it lacks strategies to focus on the learning situation and students tend not to process the experience in a learning context. This is more clear and drops Gibson's affordance terminology. From this point on, I will operate with the understanding that this is the theory driving the experiment and that the underlying purpose of the study is to determine whether students using mobile devices can alleviate the above mentioned deficits.

The paper is well cited, although some of the citations seem unwarranted (e.g., Gibson, Kirchner). Other citations appear very relevant, but not expounded upon. For example, a single sentence states some studies have found mobile technologies to be helpful on field-trip based learning. This statement is backed by citing four studies. Since those studies have already demonstrated a large portion of what this study sets out to do, more information could be provided about how this study differs from the others.

Research Design and Analysis

This study considered the effects technological support on experiential learning. The hypothesis is "that mobile technologies can increase the level of knowledge creation through experiential learning and beyond that which is achieved with traditional methods (paper and pencil)." The researchers used established statistical procedures (t-test, Mann-Whitney *U*-test, and survey results). The sample in this study was two 5th-grade classes that were not randomized. The sample size was $N=66$. The fact that this was a convenience sample presents external validity problems. Other concerns include the lack

of more detailed information about the students and lack of information about the scoring of open-ended questions.

The first investigation was a one-tailed t-test that used independent variables of students with PDAs and students without PDAs. The dependent variable was the results on a multiple choice quiz. The results showed that achievement scores were significantly higher for students with PDAs.

There are several issues with how the data was presented in this study. According to the *Reporting Results of Common Statistical Test in APA Format* from the University of Washington, “each section should restate the hypothesis and state whether your results supported it.” The hypothesis was stated only once in the paper. Data for this study was presented as “(average score 3.06, 3.19; $t=-0.37$, $P>0.05$).” Here, average score should be specified, for example, M . In addition, when the mean is given the standard deviation should be included. Also, it is important to include the sample size on which the mean has been computed. Furthermore, unless a p value is less than .001, its exact value should be reported. This study does not give exact p value for any test.

The second t-test again had independent variables of students with PDAs and students without PDAs and a dependent variable of statements on a final report. The authors included a rather lengthy excerpt from a student’s final report. Again referencing *Reporting Results of Common Statistical Test in APA Format*, it states that the “results sections should be in condensed format and lacking interpretation. Avoid discussing why or how the experiment was performed or alluding to whether your results are good or bad, expected or unexpected, interesting or uninteresting.” The authors conclusion about the student’s final report, “Notably, the girl’s descriptions showed she was engaged while

observing the plant,” is conjecture and should be avoided in this section. In addition, the paper states, “Based on this exemplary information plaque, we may assert that mobile technologies have the potential to support experiential learning in a productive way.”

This too should not be included in this section as it asserts an opinion of the researchers.

When a t-test is performed, it has three statistical assumptions: 1) Population data from which the sample data are drawn are normally distributed, 2) The variances of the populations to be compared are equal, and 3) Each observation of the dependent variable is independent of the other observations of the dependent variable. The paper does not inform us if these assumptions were addressed nor if they have been met.

The study used a questionnaire in which the students completed a five-point Likert scale. (By the way, it is preferable to use an even number scale which forces subjects to make a judgment by removing a neutral middle score.) A one-tailed Mann-Whitney *U*-test was performed on this data. Again turning to the *Reporting Results of Common Statistical Test in APA Format*, it states that “when reporting a significant difference between two conditions, indicate the direction of this difference, i.e. which condition was more/less/higher/lower than the other condition(s).” The direction of the results of the various tests were not reported.

For a Mann-Whitney *U*-test, we must assume that: 1) All the observations from both groups are independent of each other, 2) The responses are ordinal or continuous measurements, and 3) The distributions of both groups are the same, and there is a symmetry between populations. It was not stated in the paper explicitly that these assumptions were met.

Lastly, for APA format, numbers less than 10 are typically spelled out. This paper has numerous examples where this is not done (e.g., “5-point Likert scale”).

Interpretation and Implications of Results

A lack of obvious theoretical framework had implications to this study as a whole. In addition, some important concepts were not clearly defined. Specifically, they set out to test PDAs, but I could not help wondering if it was simply the digital camera attachment that was deriving all the benefits. Also, components that make up a PDA are rapidly changing and therefore the definition is changing as well. It would be useful to test how individual digital components (e.g., camera, recorder, media player, etc.) improve student performance. The other important consideration was the role novelty played in the experiment. Were students more engaged because they got to interact with something new, and performance would soon drop once the excitement has worn off?

The authors ran four statistical analyses and made several conclusions. These were: One, the group with the PDA retained more knowledge. Two, the group with the PDA created more knowledge. Three, students with PDAs were more motivated. Four, students with PDAs saved time and therefore were able to make more observations and improve knowledge gain. And five, students with a PDA did not find the sensory experience helpful.

The first conclusion, that the students retained more knowledge, appears to be correct. However, this conclusion would be more convincing if there had been a more diverse sample that had been randomly selected. The second conclusion, that the students created more knowledge, is less compelling. The students with PDAs may have included

more details about African Touch-me-nots, but they also had digital photos to draw from. The non PDA group had to sketch the flowers, which is a difficult skill to master. This makes it uncertain that the PDA group “created knowledge” just because they had more details in their final report. The third conclusion, that students with the PDAs were more motivated, is also suspect. For example, how students answered the question “I feel interested in outdoor activities” was not necessarily impacted by the use of the PDA. Since the sample sizes were relatively small it would be best to ask these questions of each participant both pre- and post-test to support the idea that the students only became interested as a result of the activity. The fourth conclusion, students with PDAs saved time and therefore were able to make more observations and improve knowledge gain, was drawn from the questionnaire. The authors make this conclusion from the positive responses in the PDA group to the following questions: “Guided by learning prompts, I feel deeply engaged in learning” and “The learning prompts helped me to observe more variety.” I am not sure how the conclusion the authors draw follows from positive responses to these questions. It is a rather large leap. The final conclusion was that students with a PDA did not find the sensory experience helpful, and based on the fact that no one from the PDA group rated the experience to be helpful, this is a safe conclusion.

The final conclusion opens the door to further studies. The authors bring up the concept of learning flow and how it can impact the process of motivation. If, for example, the PDA group engaged in the sensory experience before the photo taking, would that improve their perception of the event. The students that did sketching first did not find the experience as objectionable as the other group.

In conclusion, given the growth of mobile technologies, this field of research is pragmatic and there are many questions to consider in this area. Some primary questions would be: How do the individual digital components of these new mobile technologies compare? Do benefits wane as novelty wears off? Does changing the learning flow make a significant difference in the outcomes?