Assessing New Input Device for Educational Computer

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Abstract: - The purpose of this study was to assessing elementary students with the using of a new computer input device. A computer input device is important because of its function as a vehicle transfer users commands or wills to computer. Whenever a new device came into market, there is a need to explore its feasibility in educational usage so can be considering applications in educational fields. This study mainly focused on the input device called “Leap motion” and based upon the theory of planned behavior, TPB, the investigation of 24 elementary students was conducted to assessing their technology device using behavior. The TPB model provides a framework for understanding and predicting behavior in specific context and offered a useful platform for exploring device using intentions toward applying this new device in educational computing for elementary students. All 24 students were invited to use the input device and then the survey procedure was conducted for collecting data. According to the analyses result, it was concluded that students shows significant potential in using this new input device.

Key-Words: - Input Device, Leap Motion, TPB

1 Introduction
In this Information Age, learners have at their enormous amounts of learning activities experienced the information computer technology, ICT, used in the educational environments. These ICTs are designed for the well-organized selection, storage, and retrieval of data, and are vital for learners to construct and keep track of their knowledge formations.[1-7] All the ICT instruments require communicate users with certain input and output devices.

The purpose of this study was to assessing the possibility of applying the new input device, Leap Motion, in elementary education. Based upon a reliable behavior predicting model, TPB, an investigation research method was adopted to exploring students’ intention in using the Leap Motion device.

A computer input device is important because of its function as a vehicle transfer users commands or wills to computer. Whenever a new device came into market, there is a need to explore its feasibility in educational usage so can be considering applications in educational fields.

2 I/O Device and Behavior
Aggregating data into levels at which patterns can come into view, ordering levels into hierarchies to support drilling down and up through the levels, and using investigative functions such as lag, moving total, and year-to-date are among the techniques used to transform data into information. This information can provide a major boundary in a competitive marketplace.[8]

The computing literature often draws a sharp distinction between input and output; computer scientists are used to regarding a screen as a passive output device and a mouse as a pure input device. However, nearly all examples of human-computer interaction require both input and output to do anything useful. For example, what good would a mouse be without the corresponding feedback embodied by the cursor on the screen, as well as the sound and feel of the buttons when they are clicked?
The distinction between output devices and input devices becomes even more blurred in the real world. A sheet of paper can be used to both record ideas (input) and display them (output). Clay reacts to the sculptor’s fingers yet also provides feedback through the curvature and texture of its surface. Indeed, the complete and seamless integration of input and output is becoming a common research theme in advanced computer interfaces such as ubiquitous computing [9] and tangible interaction [10].

2.1 I/O Devices of ICT

The primary task of human-computer interaction is to shuttle information between the brain of the user and the silicon world of the computer. Progress in this area attempts to increase the useful bandwidth across that interface by seeking faster, more natural, and more convenient means for users to transmit information to computers, as well as efficient, salient, and pleasant mechanisms to provide feedback to the user. On the user’s side of the communication channel, interaction is constrained by the nature of human attention, cognition, and perceptual-motor skills and abilities; on the computer side, it is constrained only by the technologies and methods that we can invent. Research in input and output centers around the two ends of this channel:

1. The devices and techniques computers can use for communicating with people, and

2. The perceptual abilities, processes, and organs people can use for communicating with computers.

It then attempts to find the common ground through which the two can be related by studying new modes of communication that could be used for human-computer interaction (HCI) and developing devices and techniques to use such modes. Basic research seeks theories and principles that inform us of the parameters of human cognitive and perceptual facilities, as well as models that can predict or interpret user performance in computing tasks.

Advances can be driven by the need for new modalities to support the unique requirements of specific application domains, by technological breakthroughs that HCI researchers attempt to apply to improving or extending the capabilities of interfaces, or by theoretical insights suggested by studies of human abilities and behaviors, or even problems uncovered during careful analyses of existing interfaces. These approaches complement one another, and all have their value and contributions to the field, but the best research seems to have elements of all of these.

2.2 Technology Behavior based upon TPB

New input device had been introduced into our campus, and computers in education had shown the attention of these certain technology behavior of using new I/O devices. Technology behavior is interested in this study.

The theory of planned behavior (TPB) is a parsimonious model of behavior-specific cognitive determinants [11, 12]. Central to the TPB is the idea that any behavior is determined by behavioral intentions, which are a function of three independent constructs: attitude, subjective norm, and perceived behavioral control. Attitude refers to the evaluative reactions of a person, favorable or unfavorable, towards engaging in the target behavior. The first research hypothesis was set according to previous statement. \( H_1: \) It was hypnotized that there exists significant correlation between intention and attitude toward the new input device.

Subjective norm reflects individuals’ perceived expectation that significant others (e.g., peers) want them to approach or avoid the given behavior (approval or disapproval of the behavior). The second hypothesis was set according to previous statement. \( H_2: \) It was hypnotized that there exists significant correlation between intention and subjective norm of using the new input device.

In Fig 1, TPB diagram was illustrated. Beliefs in behavior, norm, and control, are the basic components of the whole model. Attitude toward the behavior, subjective norm, and perceived behavioral control are contributing to intention of the certain behavior and the intention contributes behavior. Perceived behavioral control (PBC) was added to the initial theories of reasoned action and pertains to the extent to which a person perceives personal capacities and perceives constraints regarding the target behavior. According to Ajzen [12], beyond its influence on intention, PBC is also held to determine behavior directly. The third hypothesis was set according to previous statement. \( H_3: \) It was hypnotized that there exists significant correlation between intention and perceived behavioral control of using the new input device.

The TPB has typically been well supported across a wide range of behaviors [13-16]. Studies have also specifically demonstrated its predictive utility for understanding the decision making processes that lead people to violate traffic rules [15]. Although some authors have conceded that individuals could differ in the relative weight placed
on attitudes, subjective norms, and PBC [17] and that the weights of the TPB predictors could differ across drivers’ behaviors [18, 19], these road traffic studies have limited their investigations to those independent effects postulated 20 years ago [12]. That is, in these studies, attitudes, subjective norms and PBC are considered as independent predictors of road violation behavior.

![TPB Diagram](image)

**Fig. 1. TPB Diagram**

### 3 Methodology

The purpose of this study was to assessing the possibility of applying the new input device, Leap Motion, in elementary education. Based upon a reliable behavior predicting model, TPB, an investigation research method was adopted to exploring students’ intention in using the Leap Motion device.

#### 3.1 Participants and Survey Instrument

One invited elementary six-grade class was selected based upon with the general condition of a normal elementary class in Taiwan. In this study, the new input device was provided to all 24 elementary students.

A survey was developed by researchers to include aspects related to the on-line activity, e-portfolio development, and experience gained to adequately provide insight into participating learners’ perceptions. Three items are formulated to assess the theory’s major constructs: Attitude, perceived norm, perceived behavioral control, and intention. Seven-point bipolar adjective scales are employed. Twelve items were included. The items were formulated to be exactly compatible with the behavioral criterion and to be self-directed. There are four sub-categories, attitude toward technology behavior, subjective norm, perceived behavior control of using the input device, and intention of using the input device.

A survey procedure was applied to collect data after their operation. Participants were asked to circle the number that best describes their personal opinions.

#### 3.2 Data Collection & Statistical Analysis

The data collection in this study was done by a TPB based survey instrument. There were two steps of the data collection. In the first step, participants were introduced to the new input device and hand-on operating one by one. Each participant was asked to answer the survey instrument after his/her hand-on device operating procedure.
The survey results were coded according to 12 variables of four sub-categories. In Fig. 2, a conceptual model of verifying technology behavior was drawn. The correlation statistical test procedure was adopted for verifying all three hypotheses.

For exploring students' response, both descriptive analysis and statistical test analysis were used in this study. A correlation test procedure was conducted for verifying those three hypotheses.

![Conceptual model of verifying technology behavior](image)

**Fig. 2.** Conceptual model of verifying technology behavior

### 3.3 Findings
In the following session, the findings of this study would be presented in both descriptive and statistical test. Based on the investigating results, the assessing users’ behavior toward the new input device, Leap Motion, would be concluded.

#### 3.3.1 Descriptive Analysis
There were twelve items in the survey instrument according to the TPB. The variables were grouped into intention (int1~int3), attitude (at1~at3), subjective norm (sn1~sn3), and perceived behavior control (pbc1~pbc3).

A bi-polar 1~7 scale was applied in the survey. The coding value is from 1 to 7. In Table 2, the number, minimum, maximum, mean, and standard deviation of twelve variables are listed. The number is 24 and the response value is between one and seven. The mean value of variables is around five.

<table>
<thead>
<tr>
<th>Descriptive Statistics of questionnair response</th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Minimum</td>
<td>Maximum</td>
<td>Mean</td>
<td>Std. Deviation</td>
</tr>
<tr>
<td>int1</td>
<td>24</td>
<td>4</td>
<td>7</td>
<td>5.33</td>
</tr>
<tr>
<td>int2</td>
<td>24</td>
<td>4</td>
<td>7</td>
<td>5.21</td>
</tr>
<tr>
<td>int3</td>
<td>24</td>
<td>2</td>
<td>7</td>
<td>5.50</td>
</tr>
<tr>
<td>at1</td>
<td>24</td>
<td>1</td>
<td>7</td>
<td>5.00</td>
</tr>
<tr>
<td>at2</td>
<td>24</td>
<td>4</td>
<td>7</td>
<td>5.58</td>
</tr>
<tr>
<td>at3</td>
<td>24</td>
<td>4</td>
<td>7</td>
<td>5.42</td>
</tr>
<tr>
<td>sn1</td>
<td>24</td>
<td>2</td>
<td>7</td>
<td>5.13</td>
</tr>
<tr>
<td>sn2</td>
<td>24</td>
<td>3</td>
<td>7</td>
<td>4.75</td>
</tr>
<tr>
<td>sn3</td>
<td>24</td>
<td>3</td>
<td>7</td>
<td>4.92</td>
</tr>
<tr>
<td>pbc1</td>
<td>24</td>
<td>4</td>
<td>7</td>
<td>5.37</td>
</tr>
<tr>
<td>pbc2</td>
<td>24</td>
<td>4</td>
<td>7</td>
<td>5.33</td>
</tr>
<tr>
<td>pbc3</td>
<td>24</td>
<td>4</td>
<td>7</td>
<td>5.54</td>
</tr>
<tr>
<td>Valid N (listwise)</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In Table 3, the response result were accumulated in sub-category, intention, attitude, subjective norm, and perceived behavior control. The number, minimum, maximum, mean, and standard deviation of four sub-categories are listed. The number is 24 and the response value is between 10 and 21. The mean value of variables is around 15 and 16.

Table 2 Sub-category Descriptive statistics of questionnair response

<table>
<thead>
<tr>
<th>Descriptive Statistics</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention_c</td>
<td>24</td>
<td>11.00</td>
<td>21.00</td>
<td>16.0417</td>
<td>3.81620</td>
</tr>
<tr>
<td>Attitude_d</td>
<td>24</td>
<td>11.00</td>
<td>21.00</td>
<td>16.0000</td>
<td>3.50155</td>
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<tr>
<td>norm_e</td>
<td>24</td>
<td>10.00</td>
<td>21.00</td>
<td>14.7917</td>
<td>3.41326</td>
</tr>
<tr>
<td>control_g</td>
<td>24</td>
<td>12.00</td>
<td>21.00</td>
<td>16.2500</td>
<td>3.47976</td>
</tr>
<tr>
<td>Valid N (listwise)</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.3.2 Results of Statistical Tests

Based upon the theory of planned behavior, the attitude toward using the new input device, leap motion, could be significantly contribute to form the intention of using the leap motion. The hypothesis was set as following and was tested.

$H_1$: It was hypnotized that there exists significant correlation between intention and attitude toward the new input device.

The result is listed in Table 8. The Pearson correlation between intention and attitude is 0.879 with significant value of 0.000.

Based upon the theory of planned behavior, the subjective norm of using the new input device, leap motion, could be significantly contribute to form the intention of using the leap motion. The hypothesis was set as following and was tested. The result is listed in Table 8.

$H_2$: It was hypnotized that there exists significant correlation between intention and subjective norm of using the new input device.

The Pearson correlation between intention and subjective norm is 0.595 with significant value of 0.002.

Based upon the theory of planned behavior, the perceived behavior control of using the new input device, leap motion, could be significantly contribute to form the intention of using the leap motion. The hypothesis was set as following and was tested. The result is listed in Table 8.

$H_3$: It was hypnotized that there exists significant correlation between intention and perceived behavioral control of using the new input device.

The Pearson correlation between intention and subjective norm is 0.929 with significant value of 0.000.

Table 3 Correlations between intention and three contributing variables

<table>
<thead>
<tr>
<th>Intention</th>
<th>Attitude</th>
<th>norm</th>
<th>control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson</td>
<td>.879**</td>
<td>.595**</td>
<td>.929**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.002</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
</tbody>
</table>

4 Conclusion

The theory of planned behavior (TPB) is a parsimonious model of behavior-specific cognitive determinants Central to the TPB is the idea that any behavior is determined by behavioral intentions, which are a function of three independent constructs: attitude, subjective norm, and perceived behavioral control.

Attitude refers to the evaluative reactions of a person, favorable or unfavorable, towards engaging in the target behavior. Subjective norm reflects individuals’ perceived expectation that significant others (e.g., peers) want them to approach or avoid the given behavior (approval or disapproval of the behavior). Perceived behavioral control (PBC) was added to the initial theories of reasoned action and pertains to the extent to which a person perceives personal capacities and perceives constraints regarding the target behavior.

According to the finding of this study, the new input device Leap Motion owns significant potential in been used in elementary education. According to the attitude toward using Leap Motion, elementary students’ intention could be the main factor for the users to conduct their behavior.

According to the subjective norm of using the new input device, users applying behavior could be predicted with significantly confidence. Based upon the result of perceived behavior control investigation, it is believed that the behavior of using the Leap Motion device is with significantly high possibility for the elementary students.

References:


