How Education Level Influences Internet Security Knowledge, Behaviour, and Attitude: A Comparison among Undergraduates, Postgraduates and Working Graduates

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Abstract

During the pandemic, the prevailing online learning has brought tremendous benefits to the education fields, however, it has also become a target for cybercriminals. Cybersecurity awareness (CSA) or Internet security awareness (ISA) in the education sector turns out to be critical to mitigating cybersecurity risks. However, previous research indicated that using education level alone to judge CSA level received inconsistent results. This study postulated Social Educational Level (SEL) as a moderator with an extended Knowledge-Attitude-Behaviour (KAB) model, used students’ year level as a proxy for the impact of education level, used work exposure for the influence of social education level, to compare CSA among undergraduates, postgraduates and working graduates. The participants in the study were divided into six groups, namely Year 1 university students, Year 2-3 university students, final year students, postgraduate students and young working graduates, and experienced working graduates. Human Aspects of Information Security Questionnaire (HAIS-Q) was used to conduct a large-scale survey. The Multivariate regression model analysis showed significant differences among the knowledge, attitude and behaviour dimensions across groups with different conditions of year level and work exposure. However, it was found that SEL played a more significant role than an individual’s education level. The study suggested that a greater endeavour be committed to educating the public at large together with individuals, institutes, corporate and governments to improve the national CSA level.

1. Introduction

The coronavirus’ global spread was causing ripples in all domains. The Internet has become a target for cybersecurity threats because it has become a place and platform for students to learn and employees to get to work. However, students and employees who did not major in information technology (IT) were forced to switch from offline to online in a short period of time with little ISA, posing significant security risks. For example, since the spread of COVID-19, cyber-attacks have grown in sophistication and quantity. Since such rapid digital transformations in education, for example, online learning has become a new target for cybercriminals. The investigation of cybersecurity awareness and the impact of social educational level on Chinese netizens was beneficial.

Previous research used some exciting behavioural models to assess ISA, such as the Theory of Planned Behaviour (TPB) [1, 2], Protection Motivation Theory (PMT) [3], and the Knowledge-Attitude-Behavior (KAB) model. [4] Based on KAB, the HAIS-Q was a comprehensive scale with high internal consistency and external reliability that was used to investigate internet security knowledge, attitude, and behaviour [5]. Parsons et al., [6] acknowledged that social influence should be considered when using the HAIS-Q. Hence, an extended KAB model, proposed by Hong et al., [7] was applied, which suggested that more social contact at work implied a decrease in SEL.

There were numerous studies on ISA; however, few of them were in the Chinese context, and even fewer focused on empirical research on cybersecurity risks in higher education [8], not to mention that the influence of education level on ISA was contradicted in previous research. Some studies found that
education level has a positive effect [9], while others found that it has no effect [10, 11]. This was due to the fact that, in addition to the individual's internal factors (education level), external factors of social influence were rarely the focus of the research. One research investigated the impact of the average education level of a society on one's ISA anyhow.

To assess the positive effects of education level and the negative influence of SEL, we recruited respondents with various education levels, including undergraduates and postgraduate students, and took into account three levels of work exposure, ranging from no exposure to the work environment (non-final year undergraduates) to new exposure (young working graduates) and long-term exposure (experienced working graduates). This study assumed that a higher education level would have a positive influence on higher university grades and that a lower SEL would have a negative impact on increased social contact at work. Their educational level and work experience mediated knowledge, attitude, and behaviour.

Given that relatively few large-scale ISA studies have been conducted in higher education and few attempts have been made to compare undergraduate students, postgraduate students, and working graduates, this study aimed to examine the influence of education level and SEL on students' ISA, which may contribute in a theoretical and practical way by quantifying education influence and social impact on ISA.

2 Literature Review

2.1 HAIS-Q and Extended KAB Model

A review of previous ISA studies revealed that some pre-existing, well-established behavioural models were used to investigate the issue of ISA. The Theory of Planned Behavior (TPB) [2], which evolved from the Theory of Reasoned Action [12], the Protection Motivation Theory (PMT) [13], the Health Belief Model [14], the General Deterrence Theory [15], the Technology Acceptance Model (TAM) [16], and the Knowledge-Attitude-Behaviour (KAB) model [4], all have attracted the interest of many ISA scholars [17].

The Theory of Planned Behavior's key points include intention (attitude, subjective norms) [12] and perceived behavioural control, which has been applied to adolescents' acceptance of friendship requests sent by online strangers on social networking sites [18].

The theory has been used to assess students' levels of CyberSecurity Awareness (CSA) at a private tertiary education institution [19], as well as to investigate Information Systems Security Policy (ISSP) compliance using two relevant theories, TPB and PMT [20].

The Theory of Planned Behavior was composed of two items: perceived vulnerability and perceived severity [3], which have been found to be very useful in predicting behaviours related to an individual's computer security behaviours both at home and in organisations [21]; an individual's internet security
perceptions and behaviours in a poly context [22] or an individual’s continued engagement in protective security [23] and Information Systems Security Policy compliance [24, 25].

These models, however, have been criticised for failing to capture the complexities and specific phenomena of cybersecurity [26]. The KAB, a dynamic and sometimes reciprocal model, was originally used in the health and environmental psychology area [27] as well as in the criminology and education fields [28] and has also been applied to the ISA context. [29, 30] KAB has received so much attention among scholars and has been applied to various fields of research because previous research found that knowledge alone was not sufficient to cause behavioural changes. [31]

Simultaneously, based on the KAB model, the conceptualised Human Aspects of Information Security Questionnaire (HAIS-Q) has been developed [32]. HAIS-Q research has shown that age, gender, resilience, job stress, education level, and some other personal characteristics can predict ISA to some extent [33]. In particular, education in information and communication technology (ICT) could positively benefit one's IS behaviour [34, 35]. In addition, it was also found that ISA would be higher as age increased, or among the female group, which was not consistent with findings from previous research results that no ISA difference could be seen between men and women [36], if individuals possess higher education [9], if one had more conscientious and agreeable [37]; and if one owned a propensity to take fewer risks [5]. Furthermore, if one was more resilient but underwent less job stress, they would have a higher ISA. [33] Moreover, an inverse relationship between Internet addiction, cyber loafing tendencies, and ISA has been discovered [38]. A significant positive relationship between organisational culture, security culture, and ISA [9] has also been tested from the social influence or work environment perspective. What’s more, the bank’s employees have higher ISA than the general workforce participants in all focus areas and overall [36].

Although Parson et al. [6] acknowledged in their initial HAIS-Q proposal that other social factors should be considered when using the KAB model or HAIS-Q in future research, there was no easy way to quantify social influence. To adapt the framework, Hong et al. [7] proposed an extended model of KAB (see Figure I), which suggested that more social contact at work implied a decrease in SEL.

SEL was about how the general education level of an internet user's immediate circle, such as family, friends, and colleagues, influenced the user's cybersecurity behaviours [7].

2.2 ISA Influencing Factors

When attempting to understand and shape human behaviour, looking at an individual in isolation was problematic. It was still necessary to consider the larger group, the larger social, organisational, and national systems, as well as their interactions. As a result, current studies assumed that personal, social, and national factors would influence behavioural decisions. In addition to the above-mentioned HAIS-Q factors, there were additional social implications.

Other studies have found social influence, including family, friends, and colleagues, as an important factor in motivating or discouraging IS behaviours particularly in developing countries [39, 40]. Others
demonstrated that the work environment influenced employees' perceptions of an organization's ISA [39, 41].

Furthermore, existing literature has conducted cross-national ISA research, which discovered that more secure cybersecurity behaviour was, to some extent, related to a country's higher GDP or better development, while the results were constantly changing. [42, 43].

Overall, not only did internal characteristics and the external environment appear to play a significant role in one's Internet security behaviour, but a two-factor combined investigation of its impact was lacking [39]. After all, it is currently difficult to quantify both internal and external effects at the same time.

2.3 The influences of Education Level and SEL on ISA in China

Previous research found that ISA scores increased with age [33, 36] and that individuals with a higher education had higher ISA scores [9, 44]. However, some ISA education research discovered that final-year students, who were more educated and older, consistently scored the lowest in ISA when compared to other year levels of students. To name a few, Li et al. [10] discovered that the senior group had significantly less awareness than the junior groups. Huang et al. [11] discovered that senior students were the most vulnerable to safety incidents. These findings in the Chinese context differed significantly from previous international research, in which an individual's education level was known to positively correlate with ISA [44].

At the same time, the impact of a country's GDP and development level on its population's ISA was volatile. As a result, SEL could be used as a factor to quantify external influence, including social influence and national context. SEL is concerned with how the general education level of an internet user's immediate circle, such as family, friends, and colleagues, influences the user's cybersecurity behaviours [7].

Previous research revealed some additional limitations. For example, to determine whether increased exposure to society affects ISA or whether academic growth influences it, it was necessary to compare the ISA of non-final year students, final year students, postgraduate students, as well as interns (final year students), young working graduates, and experienced working graduates. A thorough literature review, however, revealed that there had been little comparative ISA research among these three groups, namely, different year levels of university students, postgraduate students, and working graduates. Furthermore, the majority of previous research on ISA in higher education had a small sample size. A sample size of 333 to 400 for each group of respondents was theoretically the minimum for better generalizability [45].

Despite the abundance of ISA research, a recent systematic review of ISA in higher education revealed that the majority of existing ISA surveys did not meet such criteria [8].

According to the findings of the preceding study, learners' attitudes toward cybersecurity would be influenced by their internal education level and external environment, which would eventually change their
internet behaviours. Furthermore, education level had a positive effect and work exposure time had a negative effect on a person's ISA [7, 9].

Hence, the following hypotheses were proposed:

H1: University students of different years of study, postgraduate students, and working graduates will display differing cybersecurity knowledge.

H1a: Postgraduate students will score significantly higher in knowledge than final-year students.

H1b: Postgraduate students will score significantly higher in knowledge than working graduates.

H1c: Postgraduate students will score significantly higher in knowledge than non-final year students.

H2: University students of different years of study, postgraduate students and working graduates will display differing cybersecurity attitudes.

H2a: Postgraduate students will score significantly higher in attitudes than final-year students.

H2b: Postgraduate students will score significantly higher in attitudes than working graduates.

H2c: Postgraduate students will score significantly higher in attitudes than non-final year students.

H3: University students of different years of study, postgraduate students, and working graduates will display differing cybersecurity behaviours.

H3a: Postgraduate students will score significantly higher in behaviours than final-year students.

H3b: Postgraduate students will score significantly higher in behaviours than working graduates.

H3c: Postgraduate students will score significantly higher in behaviours than non-final year students.

3 Methodology

3.1 Sample and sampling method

Snowball and criterion sampling methods were used in the survey. Students were invited to complete the questionnaire via email or personal contact information, and then they contacted their peers to attend in order for the data to snowball. Furthermore, as a criterion for participation, all students were first screened as having received cyber security training during their higher education and as having completed a mandatory full-time internship for half a year or a full year in their final year of study, allowing comparisons to be made between different levels of work exposure (i.e., prior, short-term and long-term work exposure).
In total, 1882 valid responses were obtained from more than ten higher education institutions and 110 Chinese businesses. There were 480 Year 1 students, 372 Year 2–3 students, 325 final-year students, 230 postgraduate students (age range = 18–25), and 343 young working graduates, 132 experienced working graduates (age range = 18–46); 938 majored in liberal arts and social sciences, 499 natural sciences, and 445 technology and engineering; 691 males and 1191 females. Table I contains descriptive information about the participants.

Table I. A table of participants’ demographic information

<table>
<thead>
<tr>
<th>Education / working status</th>
<th>Categories</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grades</td>
<td>Year 1 students</td>
<td>480</td>
<td>25.5%</td>
</tr>
<tr>
<td></td>
<td>Year 2-3 students</td>
<td>372</td>
<td>19.8%</td>
</tr>
<tr>
<td></td>
<td>final year students</td>
<td>325</td>
<td>17.3%</td>
</tr>
<tr>
<td></td>
<td>postgraduate students</td>
<td>230</td>
<td>12.2%</td>
</tr>
<tr>
<td></td>
<td>young working graduates</td>
<td>343</td>
<td>18.2%</td>
</tr>
<tr>
<td></td>
<td>experienced working graduates</td>
<td>132</td>
<td>7.0%</td>
</tr>
<tr>
<td>Age</td>
<td>18–25</td>
<td>1550</td>
<td>82.4%</td>
</tr>
<tr>
<td></td>
<td>26–35</td>
<td>200</td>
<td>10.6%</td>
</tr>
<tr>
<td></td>
<td>36–45</td>
<td>90</td>
<td>4.9%</td>
</tr>
<tr>
<td></td>
<td>46 or above</td>
<td>42</td>
<td>2.2%</td>
</tr>
<tr>
<td>Discipline</td>
<td>liberal arts &amp; social sciences</td>
<td>938</td>
<td>49.8%</td>
</tr>
<tr>
<td></td>
<td>natural sciences</td>
<td>499</td>
<td>26.5%</td>
</tr>
<tr>
<td></td>
<td>technology &amp; engineering</td>
<td>445</td>
<td>23.6%</td>
</tr>
<tr>
<td>Gender</td>
<td>male</td>
<td>691</td>
<td>36.7%</td>
</tr>
<tr>
<td></td>
<td>female</td>
<td>1191</td>
<td>63.3%</td>
</tr>
</tbody>
</table>

The participants were divided into two groups based on our hypothesis, which stated that work exposure time had a negative effect on a person's ISA and education level had a positive effect. Internships, young graduates, and experienced graduates were thus regarded as the first short-term and long-term work exposure to a work environment. Furthermore, non-final year students, final year students, and postgraduates were viewed as three distinct educational levels.

3.2 Instrument Design
Hong's team translated, verified, and adjusted the questionnaire, which was based on The Questionnaire on Human Aspects of Information Security (HAIS-Q). It was then distributed online via one of the largest local survey platforms, Wenjuanxing, also known as Sojump. Meanwhile, each question was scored using a five-point Likert scale (5 = strongly agree, 1 = strongly disagree).

### 3.3 Data analyses

Data results (N = 1882) were analyzed by using IBM Statistic Package for Social Science (SPSS), a statistical analysis software, employing Cronbach's alpha to check internal reliability and a multivariate regression model to analyze the effect of variables, etc.

### 4 Findings

#### 4.1 Internal reliability

Each of the three dimensions was checked for internal reliability. The knowledge dimension reported a Cronbach's alpha of .84, while attitude and behaviour had an alpha value of .91 and .77, respectively, which indicated good to excellent levels of internal consistency in the subscales.

#### 4.2 Data Normality

The moderating effects of education level and work exposure on Internet security knowledge, attitude, and behaviour variables were investigated in this study.

The education level was divided into four levels: freshmen (low education level), sophomores and juniors (medium education level), seniors (higher-medium education level), and postgraduates (advanced education level). Meanwhile, work exposure was classified as follows: non-graduation years (low exposure), graduation years (medium exposure), and working graduates (high exposure).

The ISA variables were then examined for normality. Direct hypothesis testing was not recommended because both Kolmogorov-Smirnov and Shapiro-Wilk were designed for smaller sample sizes (n ≤ 50). Skewness and kurtosis values, on the other hand, were determined by hand. A larger sample with skewness between −2 and +2 and kurtosis between −7 and 7 was considered normally distributed. Mean knowledge (skewness = −.270, kurtosis = −.393), mean attitude (skewness = −.263, kurtosis = −.783), and mean behaviour (skewness = −.342, kurtosis = .351) were all within the normal range.

#### 4.3 Demographic information

According to the range provided by the questionnaire, grades were segmented into six sequential levels (Year 1, Year 2−3, postgraduate students, young working graduates, experienced working graduates, and final year). Ages (18−25, 26−35, 36−45, 46), disciplines (liberal arts & social sciences, natural sciences, technology & engineering), and genders (male, female) were also used as classification variables.

#### 4.4 Multicollinearity
Next, a multicollinearity test was performed on the data. Correlation tests were conducted for variables such as knowledge, attitude, behaviour, grade, age, discipline, and gender (see Table II for correlation results). Mean knowledge, attitude and behavior were discovered to be significantly positive and highly correlated (p < .001). There was a significant positive correlation between grade and age (p < .001), and they showed significant negative correlations with mean knowledge, attitude, and behaviour (p < .001). Therefore, grade and age as independent variables were considered covariables. To test the effect of grade, age has to be controlled.

Table II. Correlation analysis for variables

<table>
<thead>
<tr>
<th>Mean knowledge</th>
<th>Mean behaviour</th>
<th>Mean attitude</th>
<th>Grades</th>
<th>Age</th>
<th>Discipline</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean knowledge</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean behaviour</td>
<td>.780**</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean attitude</td>
<td>.765**</td>
<td>.823**</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grades</td>
<td>-.500**</td>
<td>-.415**</td>
<td>-.443**</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-.437**</td>
<td>-.352**</td>
<td>-.422**</td>
<td>.636**</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>Discipline</td>
<td>-.135**</td>
<td>-.138**</td>
<td>-.152**</td>
<td>.102**</td>
<td>.404**</td>
<td>1.000</td>
</tr>
<tr>
<td>Gender</td>
<td>.097**</td>
<td>.154**</td>
<td>.160**</td>
<td>-.028</td>
<td>-.074**</td>
<td>-.333**</td>
</tr>
</tbody>
</table>

**. Correlation was significant at the .01 level (2-tailed).

As a result, the regression analysis hypothesis was completely satisfied. Therefore, the data and residuals were normally distributed, with no heteroscedasticity or correlation between regression residuals. The potential collinearity between grade and age was identified, but it could be accommodated in the proposed regression model by controlling for the latter.

### 4.5 Data Checking

A multivariate regression model was used to examine the effects of different grade levels and levels of work exposure on mean scores of knowledge, attitude, and behaviour, as detailed below according to the corresponding assumptions. For simplicity, the changes were illustrated in Figures II, III, and IV).

**H1:**

University students of different years of study, postgraduate students and working graduates will display differing cybersecurity knowledge.
H1 was verified. There were significant differences between the knowledge of postgraduate students (M = 3.53, SD = .47) and non-final year university students including Year 1 students (M = 3.72, SD = .78) and Year 2-3 students (M = 3.64, SD = .77). Moreover, the knowledge of postgraduate students was found to be different from final-year ones (M = 3.57, SD = .77). At the same time, the knowledge of postgraduate students was also found to be visibly different from working graduates that contained young working graduates (M = 2.63, SD = .47) and experienced working graduates (M = 2.65, SD = .47). For simplicity, the differences in mean values of the three dimensions were illustrated in Table II.

H2\(a\): Postgraduate students will score significantly higher in attitudes than final-year students.

H2\(a\) was rejected. The attitude of postgraduate students (M = 3.73, SD = .69) was found to be significantly lower than final-year students (M = 3.80, SD = 1.00).

H2\(b\): Postgraduate students will score significantly higher in attitudes than working graduates.

H2\(b\) was verified. The attitude of postgraduate students was found to be significantly higher than young working graduates (M = 2.73, SD = 0.32) and experienced working graduates (M = 2.73, SD = 0.36).

H2\(c\): Postgraduate students will score significantly higher in attitudes than non-final year students.

H2\(c\) was rejected. The attitude of postgraduate students was found to be significantly lower than Year 1 students (M = 3.88, SD = 1.00), and Year 2-3 students (M = 3.77, SD = 1.02).

H3\(a\): Postgraduate students will score significantly higher in behaviours than final-year students.

H3\(a\) was verified. The behaviour of postgraduate students (M = 3.54, SD = .47) was found to be significantly higher than final-year ones (M = 3.39, SD = .82).

H3\(b\): Postgraduate students will score significantly higher in behaviours than working graduates.

H3\(b\) was verified. The behaviour of postgraduate students was found to be significantly higher than working graduates containing young (M = 2.83, SD = .28) and experienced (M = 2.88, SD = .28).

H3\(c\): Postgraduate students will score significantly higher in behaviours than non-final year students.

H3\(c\) was partially verified. The behaviour of postgraduate students was found to be significantly lower than Year 1 students (M = 3.62, SD = .82), but significantly higher than that of Year 2-3 students (M = 3.50, SD = .85).

In terms of knowledge, as students advanced to higher levels, their cybersecurity knowledge deteriorated. Their cybersecurity knowledge dropped significantly at work.

As graduates gained more work experience, their knowledge seemed to improve.
In terms of behaviour, postgraduate students performed similarly to Year 2–3 students but not as well as Year-1 students. Working graduates performed similarly poorly, but slight improvements could be seen after gaining more work experience. In terms of attitude, as students advanced to higher levels, became postgraduate students, and went to work, their cybersecurity attitudes deteriorated. Even inexperienced employees showed no improvement.

4.6 Gender difference

Many studies have hypothesised that personal factors such as gender influence behavioural decisions [36, 48]. The analysis revealed that the hypothesis was statistically supported. Females' knowledge (M = 3.44, SD = .78) was found to be significantly higher than males' (M = 3.27, SD = .78), as was their attitude (M = 3.66, SD = .94 vs M = 3.32, SD = .99). The same was true for female and male behaviour (M = 3.44, SD = .70 vs M = 3.19, SD = .81). As a result, females had higher ISA scores than males in all three dimensions.

4.7 Significant Predictors

A multivariate regression model was also run to see if age, discipline, grade, or gender were significant predictors of ISA. Previous research suggested that age was a significant predictor of ISA (e.g., [49], but a recent study found that age was not a significant predictor [7]. Since then, the most stable, whose value was always positive, Pillai's Trace, to test the sum of a matrix's eigenvalues, and Roy's Largest Root statistic, to test the maximum value in a matrix's eigenvalues, have been used. And the greater the magnitude of these values, the greater the contribution of this effect to the model. Wilk's Lambda was also used, with a value between 0 and 1. In Wilk's Lambda, the smaller the value, the greater the contribution. As a result of the above analysis, the results showed that, overall, grade and gender were significant predictors of ISA, whereas age and discipline were not.

4.8 Significant Correlations

In addition, tests of between-subjects effects were examined further, with mean knowledge, mean attitude, and mean behaviour as the dependent variables.

Significant correlations were discovered between grades, discipline, and gender.

According to the Sum of Squares, the grade had the greatest impact on knowledge (112.96), attitude (123.35), and behaviour (70.33), in that order.

(See Table III.)

Table III: Tests of Between-Subjects Effects
### 4.9 Discipline Differences

To the best of the authors' knowledge, ISA research in higher education rarely focuses on discipline. Thus, Fisher's LSD was used in this study for inter-group multiple comparisons to compare disciplines. The analysis found no difference between the disciplines of natural sciences and technology and engineering, but there was a difference between the above two disciplines and the discipline of liberal arts and social sciences. That was because, in Chinese universities, the disciplines of natural sciences, technology, and engineering had at least two programme design courses and one professional computer application course, whereas students majoring in liberal arts and social sciences only took the common course of Fundamentals of College Computing in the first year, according to the Computer Basic Curriculum System and the actual investigation [50, 51].

### 5 Discussion

Previous studies used GDP and country development to predict citizens' ISA (e.g., [30, 42]), but the research results were inconsistent (e.g., [22, 42]). Research by Hong et al. found that reason is seldom considered national/social education level in the previous research [7]. Some studies found a positive correlation between education level and ISA around the world [9, 44], while others found negative correlations in the Chinese context. [11, 44, 52] The current survey was one of the few, if not the first, studies that used students' year level as a proxy for the impact of education level as an internal aspect and work exposure for the influence of social education level as an external factor, both of which we
consider to be quantifiable sources of impact. In contrast to studies on online security awareness among university students, postgraduate students, and working graduates, which could reveal changes in online security knowledge, attitudes, and behaviour among individuals, the context of this study was in China, where university graduates were more likely to work with colleagues who were less educated than themselves. As a result, we compared the impact of education and social education levels on Year 1 university students, Year 2 and 3 university students, final year students, postgraduate students, and young working graduates with experienced working graduates.

To our surprise, there was little difference in overall ISA between graduate students and college students, implying that EL had little impact on these students.

The most important reason, however, is that there were few computer-related courses at the higher levels of undergraduate and postgraduate study in most Chinese universities.

To be more specific, only a few universities provided optional computer-related courses or computer common courses to postgraduate students [51, 53], implying that the majority of them did not receive better ICT education at the postgraduate level, despite taking the common course Fundamentals of College Computing in their first year as undergraduate students [50, 51]. As a result, higher levels of undergraduate and postgraduate students’ information and communication technology (ICT) knowledge could not be enriched, and thus could not positively influence their attitude. After all, ICT education could be beneficial to one's ISA [34, 35]. What we didn't expect was that education level had no effect on postgraduates' cybersecurity behaviours, while it had a negative impact on postgraduates' Internet security knowledge and attitude.

However, because of the influence of SEL, the fact that the average difference in ISA between working graduates and the other two student groups was significant provided insight into the importance of conducting a survey on working postgraduates and working PhDs, given that the SEL of the working environment for working postgraduates may be better. Nonetheless, the behaviour of postgraduate students was significantly higher than that of final-year students, indicating that the negative effects of society (SEL) were offset by the positive effects of the university environment (education level). With this in mind, an ISA survey of Ph.D. students was undoubtedly a worthwhile topic worthy of further investigation.

Overall, social influence was more important than an individual's level of education. This result differed from previous international findings [9], but was consistent with previous Chinese findings [12, 52]. Furthermore, as expected, females had better attitudes and behaviour than males, which was consistent with previous findings [36, 48]. The outcome was as expected: there was a significant difference between liberal arts and social sciences and natural sciences, technology, and engineering.

6. Conclusions
This study used an extended KAB model, which proposed that year level (grade) could act as a moderator in the relationship between knowledge and attitude. As a result, three main hypotheses and three sub-hypotheses were proposed based on the respondents' various conditions. In other words, the postgraduate student group has the highest education level, while the final year students and non-final year students decrease in order. These conditions represent various levels of educational influence. At the same time, postgraduate students return to the university environment after having had some contact with work, representing the group that has been influenced by education level and SEL.

On this basis, the Human Aspects of Information Security Questionnaire (HAIS-Q) was used to assess the extended KAB model. The effect of grade and work exposure on mean knowledge, attitude, and behaviour scores was investigated. The findings confirmed that education level and SEL had a statistically significant effect on variables.

Three major hypotheses were found to be correct. H1-University students of various years of study, postgraduate students, and working graduates will demonstrate varying levels of cybersecurity knowledge was confirmed. There were significant differences in knowledge among university students of various years of study, postgraduate students, and working graduates.

H2a–H2c examined whether there would be statistically significant differences in attitudes among four groups of respondents. Non-final year students performed better than the other three groups. Furthermore, final-year students had higher scores than postgraduate students, and postgraduate students had higher scores than working graduates.

H3a to H3c also considers whether the behaviours of four groups of respondents will differ. Postgraduate students scored higher than final year students and working graduates, but their scores were comparable to non-final year students.

The current study was one of the first to compare postgraduate students with university students and working graduates in order to examine the cognitive and behavioural changes of well-educated individuals. It contributed to methodology and practise guidance. The findings of this study need to be confirmed by additional research, but it could serve as a starting point for future research.

7. Implications And Limitations

7.1 Implications

An important methodological implication for the future was that, with readily available figures of national education level, the year level (education level) and length of time at work (SEL) were quantifiable measures, similar to existing cross-national findings (e.g., [22, 42, 43]. As a result, it addresses the issue that GDP and nationality are inconsistent predictors of national ISA.
Furthermore, the results of numerous ISA studies that examined education influence in the context of individual factors have been contradictory. The underlying cause was that individual factors should be considered alongside the influence of social forces. As a result, even with a degree, working in different countries and at different social education levels could result in very different behaviour. As a result, the disparity between international and national research findings could be better explained.

This study found that students valued education about Internet security and cybersecurity behaviour, and that a greater effort needed to be made to educate the general public, particularly while they were still in school. With 95.41% of the population in China having received an education, cybersecurity awareness training at the school level was critical to improving the national ISA and SEL. What was more important was the higher education group's knowledge of ICT. The ICT knowledge that remained only in the freshmen stage could no longer meet the current era of extensive and in-depth popularisation of the Internet, and thus the ICT knowledge needed to be provided according to the needs of students at various stages, including the postgraduate stage. Simultaneously, because teachers' ICT knowledge can influence the younger generation, the quickest and most effective strategy was to train the teacher population on ICT knowledge.

Meanwhile, companies should consider providing more training for employees with lower education, who make up 48.8% of the workforce in China, as well as maintaining young graduates' better ISAs, to ensure that all employees have a broad range of ICT knowledge. Simultaneously, it was critical for the government to take actions to promote safe Internet behaviours among citizens, such as broadcasting knowledge and the importance of ISA via social media, online advertising, television, government-led talks, establishing network security policies, and collaborating with businesses to initiate social transformation.

7.2 Limitations

The study attempted to collect a larger sample in the hope that a larger sample would reduce any statistical significance and thus mitigate the problem of non-random sampling. However, due to the varying difficulty of data collection in each group, the number of respondents in each of the six groups varied.

The finding was limited by a lack of reliable responses, so we have already argued the need for comparisons among the six groups mentioned above, working postgraduates, Ph.D. students, and working PhDs, particularly in the form of longitudinal studies, to understand the macro picture and how changes were occurring.

Future research could also conduct cross-country studies to investigate the influence of education level and SEL on ISA using this extended model to further our understanding of education level and SEL.

Declarations

Disclosure statement
The authors report there are no competing interests to declare.

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References


Figures

![Diagram](image)

Figure 1

An extended KAB model

Figure 2
Knowledge

Figure 3
Figure 4

Behaviour