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Assessing self-efficacy and college readiness level among new undergraduate students in computer science using metacognitive awareness inventory (MAI)

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Abstract. This preliminary study was conducted to address the issue of academic planning skills among new university student. Due to lack of proper measurement mechanism for awareness and readiness among students, this study proposes Metacognitive Awareness Inventory (MAI) to assess the connection between student self-efficacy and college readiness. Qualitative and quantitative approach were used by provide an online self-assessment for new student of Faculty of Computer Systems & Software Engineering (FSKKP) and analyse the data respectively. The possible relationships between MAI and College Readiness Item (CRI) in self-assessment has been evaluated. The sample size of 368 respondents from UMP are responding to the online self-assessment. The initial finding shows most student (71%) of the respondent lack of skills in planning. We manage to use *Pearson Product-moment* correlation coefficient to find the significant relationship between MAI and CRI. Thus, we found that College Readiness provide sufficient evidence that there is a significant correlation with most of MAI items. The findings also indicated not much difference was found between gender in terms of self-efficacy level. This paper suggests the MAI and CRI is a reliable and valid scale to respond the planning skills issues among new university students.

1. Introduction

Metacognitive Awareness Inventory (MAI) has been developed by [1] to evaluate metacognition as comprised of two major components: metacognitive knowledge and metacognitive regulation. Metacognition plays an important role in helping learners in learning process [2–4]. The MAI consists of 52 statements relate to the both metacognition components which assign the ability to monitor and control one's learning [1,5,6]. Metacognitive knowledge includes three sub-processes: declarative, procedural, and conditional. Declarative knowledge means knowledge about self and the strategies. Procedural knowledge is to know how to handle the procedures in study strategies. Conditional knowledge refers to the knowledge about *when* and *why* to use the strategies [5,7]. Whereas, metacognitive regulation also includes three sub-processes: planning, monitoring, and evaluation. This sub-processes more to the steps which an individual take to solve problems, set goals and analyse what they are studied about [5,7]. The findings of MAI in these study can be used [1,7,8] to assess the self-efficacy and college readiness among new students.

As mentioned by [9], self-efficacy is capabilities of one's beliefs to produce the required level of performance. There is an evidence [10] indicates students who are performed in study posse a high level of self-efficacy. Furthermore, there are other studies [11–13] recommended that self-efficacy correlates highly with college achievement. Besides, it is also affected to academic achievement and motivation [13], students with high level of self-efficacy are more prepared, hardworking, pursue challenging goals, increase effort to perform the goals, and able to deal with problems [9,10]. These findings supported by [10] defined that students need to build a strong belief that they can complete the task successfully, rather than relying on the ability and skills to perform well on academic tasks. Furthermore, in following research, the result shown that self-efficacy beliefs be related to decisional behaviors and various indices of career choice [13].

The lack of college readiness skills is a national issue in certain countries as addressed in many previous studies [14–16]. Malaysia is also not exempted in facing this challenging issue in higher education particularly for the new higher education system defined in Malaysia Education Blueprint 2015-2025 (Higher Education) [17]. In a study conducted by [18], lack of college preparation can be caused by the gap that exists in high school learning and what is expected when students reach college. College-ready student is one that capable to understand what is college expected, know the content knowledge, and can adapt the key intellectual lessons as defined by [16]. There is very little research that address college readiness in education area. The development and employ an instrument that assess the college readiness will be constructed in this study.

This paper presents the investigation on self-efficacy and college readiness among new undergraduate students in computer science discipline. This study is important in emphasizing the issue of planning skills in academic among new university student, since there is no proper mechanism to measure student awareness and readiness to venture their life in university environment. The following research questions have been searched in this designated study:

1. Is there a significant difference among new students in term of degree of awareness studying at university?
2. Is there a significant relationship between MAI and college readiness instrument?
3. Is there a significant difference between gender in term of self-efficacy level based on MAI instrument?

Hence, the aim of the study is to assess the connection between new students' self-efficacy and college readiness by analyse data using MAI instrument.

2. Literature Review

2.1. Self-efficacy
This preliminary study has reviewed self-efficacy in education area that address student self-efficacy and academic performance. [19] mentioned that a deep or strategic approach to general learning are being adopted for students with a high self-efficacy relating their reading and writing abilities, others with a low self-efficacy (reading and writing) adopt a surface approach. Students with a high self-efficacy adapted better in college [20]. The high school grade point average and student self-efficacy were strongly correlated in college setting with academic performance measured by course grades [21]. Literatures shown that [10,11,22,23] student self-efficacy and academic performance have a strong positive correlation. However, there is a need to develop a general scale for students, thus MAI instrument is the best option to be implement as measurement for self-efficacy among students.

2.2. College readiness
[16] mentioned college readiness as preparation level for student to enrol and succeed without remediation in a credit-bearing general education course at a postsecondary institution. "Succeed" is determined as finishing entry-level courses at a level of understanding and skill that makes it possible

for the student to consider taking the next course in the sequence or the next level of course in the subject area [16]. College readiness skills are categories into four element included content knowledge, contextual skills and knowledge, cognitive strategies and academic behaviors, which would familiarize the student with a college environment [24]. From this review, it come out with those approaches. However, it seems there are few sources that study about the relationship of college readiness with other instruments to measure the confidence in student awareness in their study. Thus, this paper will evaluate the relationship between college readiness and MAI instrument.

2.3. Metacognitive Awareness Inventory (MAI)
This study has examined MAI in relationship to the academic achievement, learning skills and self-regulation of students in academic area [18]–[21]. [25] investigated the MAI intent on how it relates to broad and single measures of academic achievement in college students. As a result, a significant correlation between the MAI and cumulative GPA as well as end of course grades were found. Based on [26] the findings show significant correlations between metacognition and academic monitoring. The result on [27] indicated that metacognition level and self-efficacy has a weak relationship based on *Pearson* correlation coefficient and *linear regression* test indicated a positive and significant relationships.
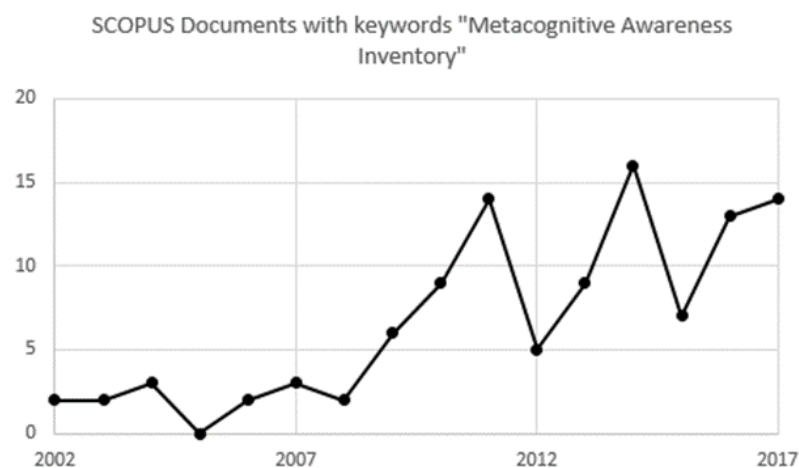

Figure 1. Search Result from SCOPUS database with keywords "Metacognitive Awareness Inventory" retrieved on 8 November 2017.

Based on our search in SCOPUS database, the use of MAI is to evaluate or assess students' skills for learning purpose in various subject area is still in infancy stage with 112 documents retrieved globally, although we can still take this as a reference that the MAI instrument can be used for this preliminary study (Figure 1).

3. Methodology

3.1. Study subjects
This preliminary study is conducted in qualitative and quantitative approaches by analysing data from MAI and CRI. The CRI is an instrument devoted in UMP context and includes 4 items regarding students' preparation at university. Although there is a specific instrument for measuring the self-efficacy, there also other studies used MAI to measure or associate with self-efficacy[8,28]. The MAI items shown in Table 1 [25]. These two instruments, were used by respondents in the self-assessment with a true or false choice and 5-point Likert scale (strongly agree, agree, neutral, disagree and strongly disagree) respectively. The qualitative approach has been used in detailed description of observations

and individual insights of the respondents [22]. While the quantitative approach to quantify the self-efficacy and college readiness among UMP students by applies statistical techniques to recognize patterns [22] whether this preliminary study is applicable or not. The MAI and CPI is a general self-assessment has been used in an online environment targeting respondent among new FSKKP students. The rational online self-assessment has been used is, data collection easy to manage within the time, it is well accepted especially relate with this kind of self-assessment method, and in this era of technology, students have their own smartphone to access it on time. The session was conducted on 23rd September 2017 with 368 respondents by distributing the Google form link through First Year Seminar (FYS) held at Universiti Malaysia Pahang (UMP).

Table 1. MAI items.

Components	Items	Number of items
Knowledge about Cognition	Declarative Knowledge	8
	Procedural Knowledge	4
	Conditional Knowledge	5
Regulation of Cognition	Planning	7
	Information Management Strategies	10
	Comprehension Monitoring	7
	Debugging Strategies	5
	Evaluation	6

3.2. Data analysis

Two dependent variables regarding students' self-assessment, MAI (Dependent Variable) and CPI (Independent Variable), were analysed in this study. *Pearson Product-moment* correlation coefficient was used to evaluate possible relationships between MAI and CPI items respectively. A factor of $\alpha=0.05$ and p value less than 0.05 was considered statistically significant. A common spreadsheet application (Microsoft Excel 2016) was employ as a statistical tool for data analysis purpose.

4. Results and Discussion

This section provides the relevant results for data analysis from MAI and CRI. The percentage of students' preparation is summarized in Table 2.

Table 2. Percentage of students' preparation (*n*=368).

Concept	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
College Readiness					
CR1: Actually, I don't fully understand how UMP grading system Cumulative Grade Point Average (CGPA) works.	6(2%)	58(16%)	**159(43%)**	111(30%)	34(9%)
CR2: Actually, I have no idea what is new UMP grading system Integrated Cummulative Grade Point Average (iCGPA) works.	11(3%)	95(26%)	**157(43%)**	82(22%)	23(6%)
CR3: At this moment, I have no idea how to get first class award upon my graduation.	20(5%)	66(18%)	**124(34%)**	107(29%)	51(14%)
CR4: At this moment, I never thought what kind of career I would do after completing my study.	22(6%)	61(17%)	110(30%)	**123(33%)**	52(14%)

Table 2 show that new students are mostly in balance criteria for the college readiness. Due to most of feedback dominated at neutral scale, we found it is difficult for us to distinguish either students were having readiness or not. Thus, Case 1 and Case 2 are being developed to provide a clear picture for the scenarios analysis as shown in Figure 2. Case 1 is a scenario with assumption to those who choose neutral scale are tend to not ready or grouped with the scale strongly agree and agree, while Case 2 refers to those who choose at neutral scale tend to have some readiness. As illustrated in Figure 2, the career scenario in Case 1 shows (52%) students are not concerned about their future career. Whereas, Case 2 shows mostly students are well prepared in all items.
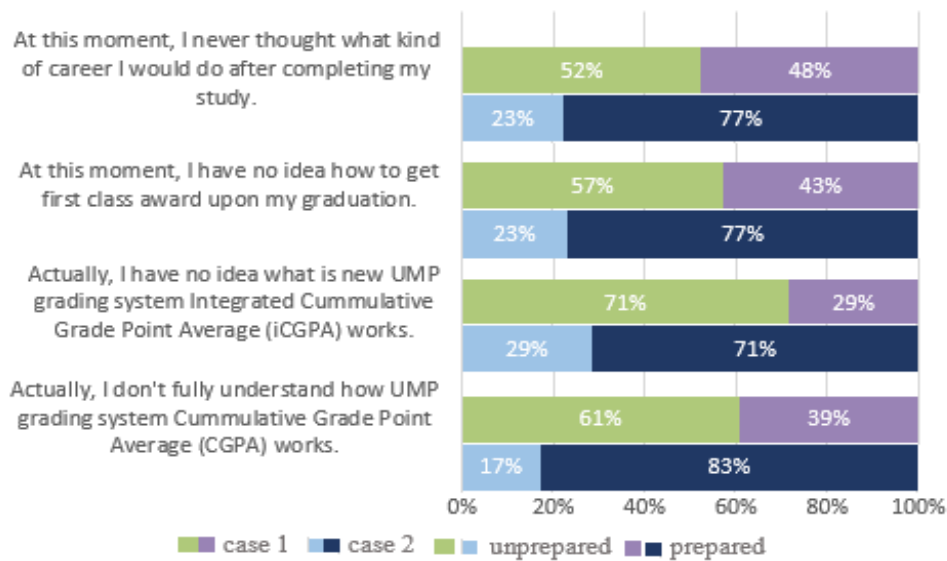

Figure 2. Percentage of student readiness based on case 1 and case 2 (n=368).

Based on Table 3, it indicates the percentage of students' self-efficacy using MAI instrument. Majority (90%) of respondents are not competent in declarative knowledge and (71%) of the respondent lack of planning skills.

Table 3. Percentage of students' self-efficacy using MAI (*n*=368)

MAI	Competent	Not Competent
Knowledge about Cognition		
Declarative Knowledge	10%	90%
Procedural Knowledge	42%	58%
Conditional Knowledge	38%	62%
Regulation of Cognition		
Planning	29%	71%
Information Management Strategies	23%	77%
Comprehension Monitoring	30%	70%
Debugging Strategies	62%	38%
Evaluation	24%	76%

Table 4 depicts the possible relationships between items related to MAI and CRI. The MAI divided by 8 categories and each category will be associated with CRI to find the statistically significant between them. Among the 8 categories, only Information Management System and Debugging Strategies not have significant relationship with CRI. The relationship between Conditional Knowledge and CRI was

found as a highest significant positive correlation of $r(366) = 0.2458$ ($n=368$, $\alpha=0.05$, $p<0.001$), but it still showing a weak positive correlation, followed by Procedural Knowledge and Declarative Knowledge (**Table 4**).

Table 4. Relationship between MAI and CRI ($n=368$, $\alpha = 0.05$, $p < 0.05$).

MAI	College Readiness			
	r	t	df	p
Declarative Knowledge (DK)	0.2172	4.2575	366	2.63×10^{-5}
Procedural Knowledge (PK)	0.2222	4.3599	366	1.69×10^{-5}
Conditional Knowledge (CK)	0.2458	4.8512	366	1.82×10^{-6}
Planning (P)	0.1677	3.2545	366	1.24×10^{-3}
Information Management Strategies (IMS)	0.0440	0.8427	366	3.99×10^{-1} *
Comprehension Monitoring (CM)	0.1496	2.8950	366	4.02×10^{-3}
Debugging Strategies (DS)	0.0919	1.7665	366	7.82×10^{-2}*
Evaluation (E)	0.1433	2.7696	366	5.90×10^{-3}

not significant

Figure 3 shows overview of how strong the relationship between the items of MAI and CRI. It shows that the green line is the strongest relationship between them, but the red line indicates there is no significant relationship between CRI with Information Management Strategies and Debugging Strategies respectively.
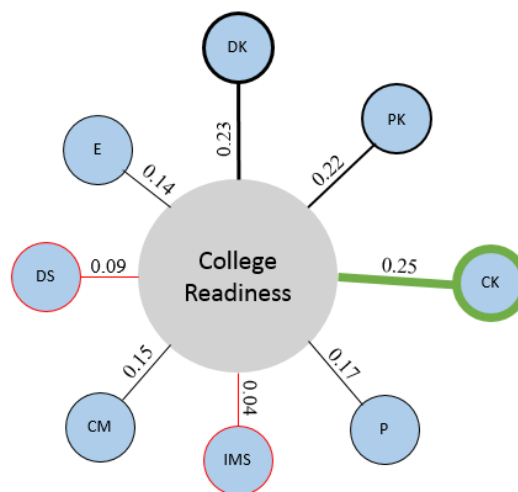

Figure 3. Relationship between MAI and CRI.

Table 5 shows the results of the MAI comparison, based on whether the student was male or female. The MAI is divided into 8 categories and we compare how many respondents feedback for each MAI items through status (1 = Good, <1 = Need Improvement) on both gender. The good status means that the students already prepare for their study in university level and vice versa. The result shows the status "1" and "<1" of male and female students was examined and found there is not much difference between both gender, average difference is between 1 to 17 percent. Table 5 shows male DS is 51% and 49% and female DS is 68% and 32% respectively.

Table 5. Self-efficacy differences between gender through MAI instrument

Gender	Status (1 = Good, <1 = Need Improvement)	DK	PK	CK	P	IMS	CM	DS	E
Male (130)	1	16 (12%)	53 (41%)	45 (35%)	28 (22%)	20 (15%)	33 (25%)	66 (51%)	27 (21%)
	<1	114 (88%)	77 (59%)	85 (65%)	102 (78%)	110 (85%)	97 (75%)	64 (49%)	103 (79%)
Female (238)	1	20 (8%)	100 (42%)	96 (40%)	78 (33%)	64 (27%)	78 (33%)	163 (68%)	63 (26%)
	<1	218 (92%)	138 (58%)	142 (60%)	160 (67%)	174 (73%)	160 (67%)	75 (32%)	175 (74%)

5. Conclusion

According to the findings of this preliminary study, self-efficacy and college readiness level among new students using MAI found that majority students have low awareness about studying at university. This finding indicates that students are not well planned about their future careers and potential for not having initial plans to address the changing nature of works in future due to Industry Revolution 4.0. The differences found between male and female students illustrated in Figure 3 can be considered as no different gender perception regarding to the self-efficacy level. Although the significant relationship between MAI and CRI were found, the associations is still unclear since there are two MAI items; Information Management Strategies and Debugging Strategies are not significant to CRI. Based on this finding, we found that the neutral scale might not be included in the self-assessment since it potentially gives unprecise analysis for evaluation. Besides, the proper instrument need to be further developed and how it can be officially 'compulsory' subscribed by all new students in a more engaging gamification approach fitting the nature of millennials through interactive analytics or personalized dashboard. Therefore, more research is needed to investigate the theoretical and application in measuring self-efficacy and college readiness among new students.

Acknowledgement

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