

Academic Self-efficacy as a Precondition for Critical Thinking in University Students

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ABSTRACT

Critical thinking is considered one of the key competencies of university students and its importance increases with the effort to develop students' creativity, independence as well as scientific thinking. For this skill, it is important to have confidence in one's ability to solve problems, find relevant answers or to formulate defensible conclusions. The aim of the paper was to determine whether academic self-efficacy acted as a precondition for critical thinking in university students. A total of 451 university students were involved in this study. The data were obtained by The Critical Thinking Disposition Inventory and the Academic Self-Efficacy Scale. The results showed that academic self-efficacy predicted all the three dimensions of critical thinking, albeit with a small amount of explained variance ranging from 8.1 to 12.2%. Although the main factor moderating each dimension of critical thinking is the effect of academic self-efficacy, a gender interaction effect was also found, which was more evident for males than females.

Keywords: Academic self-efficacy, critical thinking, teachers; university students.

INTRODUCTION

The importance of critical thinking as a crucial skill and its development is indisputable in the current academic environment. Critical thinking is considered as one of the key competences of university students (Hasanah & Malik, 2020; Lloyd & Bahr, 2010; Hizriani et al, 2022; Uribe-Enciso, Uribe-Enciso, & Vargas-Daza, 2017; van Peppen et al., 2018,). Its importance increases with the effort to develop students' creativity, independence as well as scientific thinking (Arisoy & Aybek, 2021). The importance of supporting critical thinking in students is also associated with their ability to cope with the demands placed on them by the 21st century society which is characterized by rapid development, changes and progress not only in the technological field. We often speak of the so-called digital age in which we face a huge increase in often contradictory information of different quality and relevance but also in the social and economic areas where these skills are crucial not only for the development of the individual but for all democratic societies (Crenshaw, Hale, & Harper, 2011; Minnameier & Hermkes, 2020; Öz & Balyer, 2018; Uribe-Enciso et al., 2017). In a sense, critical thinking can be perceived as scientific thinking denoting specific skills that can be built and developed (Cahyono, Kartono, Waluya, Mulyono, & Setyawati, 2021; Lilienfeld, Ammirati, & David, 2012; Schmaltz, Jansen, & Wenckowski, 2017). Specifically, these are cognitive skills or strategies which can be described as thoughtful, purposeful, justified and targeted and which manifest in the ability to solve problems, formulate conclusions, calculate probabilities or make decisions relevant to the context and type of thought task where one of the key aspects of this skill is the ability to avoid bias in thinking and decision making (Dwyer, 2017; Halpern & Dunn, 2021; Heard et al., 2020; R. F. West et al., 2008).

In terms of personality characteristics, self-efficacy plays an important role in the academic environment as it significantly affects how students approach their abilities as well as study and to what extent they are able to cope with the number of requirements that occur in this environment. Self-efficacy is related to confidence which individuals have in their skill set to cope with specific tasks and requirements (Bandura, 1997; Jordan & Carden, 2017). Self-efficacy beliefs regulate human functioning through cognitive, motivational, affective and decisional processes (Bandura, 1997). In the academic environment, self-efficacy is perceived primarily as students' beliefs about their ability to organize and perform various required activities

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(Gutiérrez García & Landeros Velazquez, 2020) as well as the ability to anticipate their behaviour and emotions in different academic situations in relation to cognitive processes (Doménech-Betoret, Abellán-Roselló, & Gómez-Artiga, 2017). Self-efficacy is related to metacognition which is a process that controls cognitive processes and executive functions (Cera, Mancini, & Antonietti, 2013; Gutiérrez-García, Huerta-Cortés, & Landeros-Velazquez, 2020; Karaoğlu-Yılmaz, Yılmaz, Üstün, & Keser, 2019; Medina, Castleberry, & Persky, 2017). A high degree of self-efficacy thus facilitates information processing and cognitive performance (Bandura, 1997; Mafla, Divaris, Herrera-López, & Heft, 2019) and in the educational context leads to a tendency to interpret academic activity as a challenge that needs to be faced in an effective and consistent way, with confidence in one's abilities and towards more effective use of knowledge and skills (Honicke & Broadbent, 2016; D. H. Schunk & DiBenedetto, 2016).

Self-efficacy appears to be an important factor of critical thinking. For the critical thinking skill it is important to have confidence in one's ability to solve problems, find relevant answers to specific question or to formulate defensible conclusions (Dehghani, Sani, Pakmehr, & Malekzadeh, 2011; Dwyer, Hogan, Harney, & Kavanagh, 2017; Gloudemans, Schalk, & Reynaert, 2013; Hyytinen, Toom, & Postareff, 2018; S.-L. Wang & Wu, 2008). At the same time, a higher degree of self-efficacy functions as a good predictor for the use of high-level learning strategies such as critical thinking (Nazemi, 2016; S.-L. Wang & Wu, 2008). A similar role is played by the motivational component of self-efficacy which supports or directs students' efforts towards the development of their ability to think scientifically (Bandura & Locke, 2003; Dehghani et al., 2011). On the other hand, it is clear that the relationship between these constructs also works the other way. Critical thinking can be considered as a predictor for self-efficacy (Odacı & Erzen, 2021). In order to assess one's self-efficacy, it is essential to use cognitive skills (Bandura, 1997; van Dinther, Dochy, & Segers, 2011); a higher quality of cognitive abilities (for example a better ability to integrate information from multiple resources) makes the belief about one's coping ability more accurate (Chen, Casper, & Cortina, 2001; Karaoğlu-Yılmaz et al., 2019).

Although the concepts of critical thinking and self-efficacy are widely spread and explored in the academic environment, their mutual relationships have so far been the subject of only few studies and their mutual functioning mechanisms are thus little known (often because critical thinking can be considered indirectly on the basis of studies examining metacognition and other forms of thinking), especially in relation to university teacher training students who are or should be the instigators of the development of critical thinking and strengthening of self-efficacy in their future pupils and students.

METHOD

The following sub-headings should be used in this section.

Research Design

The research model has been conducted as a quantitative study. The research design uses a direct survey technique. The aim of the study was to determine whether academic self-efficacy acted as a precondition for critical thinking in university teacher training students.

Population and Sample

A total of 600 students from the Faculty of Education at Palacký University Olomouc were selected randomly by distributing questionnaires to participate in the research. Eventually, we obtained a total of 451 completed surveys back (75.2%). The sample involved 451 teacher training students of whom 434 were female and 17 were male. The basic description of the sample is shown in Table 1.

The study was conducted in compliance with applicable ethical principles. The research study involved university students on a voluntary basis; the participants were informed about the possibility to terminate their participation at any stage of the research without giving a reason. The participants consented to anonymous data processing and use of data for scientific purposes. In the course of online data collection, no specific information was collected that would allow the identification of specific students (including for example IP address, student name or identification number, specific field of study, etc.).

Choose one of the above depending on the nature of the study. Quantitative studies should contain detailed and clear information regarding the population of the study, the sample and the sampling method. Relevant characteristics of the sample should be stated.

In qualitative studies, *study group* should be preferred instead of *sample* since such studies are conducted with few individuals or units. The individuals or units forming the study group should be introduced with all relevant characteristics. Information regarding the context of the study group should also be explained here.

Data Collection

The data were collected using a Google Forms online survey consisting of two parts. The first part contained demographic

Table 1: Sample characteristics

	Sample	Females	Males
N	451	434	17
Agea	22.8 ± 5.8	22.8 ± 5.8	23.5 ± 5.3

^aData presented as mean ± SD

questions and an informed consent. The second part consisted of two psychological tools.

The Critical Thinking Disposition Inventory (CTDI; Wang et al., 2019) is an instrument that measures the dispositions to students' critical thinking. The method includes 18 statements assessed on a 5-point Likert scale using the following three factors: open mindedness, systematicity/analyticity and truth seeking. In all three factors, the reliability of the questionnaire achieves a very good level of $\alpha = .86, .85, .82$.

The Academic Self-Efficacy Scale (ASES; Jerusalem & Schwarzer, 2003) is an extended instrument that measures academic self-efficacy. The questionnaire comprises seven items that measure the degree of the construct on a 4-point Likert scale. The reliability of the questionnaire achieves an acceptable value of $\alpha = .79$.

Data Analysis

Descriptive statistics were conducted for the socio-demographic variables (age, gender, education). No missing values were detected. The Pearson correlation analysis was used to test the presence of relationships between potential predictors and dependent variables. Subsequently, the main analysis was conducted using the multiple linear regression with academic self-efficacy as a predictor and gender as a covariate. Any 2-sided $p < .05$ was considered statistically significant. Data analysis and visualization were performed in the R (v.4.1.0, www.r-project.com) environment with stats, corplot, predict3d, rgl and ggplot2 packages.

FINDINGS

The initial correlational analysis confirmed the associations between academic self-efficacy and the dimensions of critical thinking, as well as the possible influence of gender (Table 2, Figure 1A). A subsequent series of linear regression analyses showed that academic self-efficacy significantly predicted all three dimensions of critical thinking: open-mindedness ($b = 0.058$, $P = 1.35e-04$), systematicity/analyticity ($b = 0.048$, $P = 4.1e-10$) and truth seeking ($b = 0.060$, $P = 1.98e-12$), albeit with a small amount of explained variance ranging from 8.1 to 12.2% (Table 3, Figure 1B). Higher academic self-efficacy has always been associated with better levels of critical thinking.

The findings obtained from data analyses should be presented in line with the aims of the Figure 1. The effect of academic self-efficacy on critical thinking. (A) the initial correlogram shows significant associations between the variables of interest. (B) Scatterplots with regression lines show the stand-alone effect of academic self-efficacy on individual dimensions of critical thinking. (C) 3D scatterplots show the interaction between sex and academic self-efficacy in affecting individual dimensions of critical thinking.

Regarding the fact that the correlation analysis suggested a possible effect of gender, a multiple linear regression was also applied. The results showed that the effect of academic self-efficacy remained the main factor that moderated the dimensions of critical thinking. However, in the case of open-mindedness and systematicity/analyticity, an interaction effect between gender and academic self-efficacy was also

Table 2: Mean \pm SD values of the investigated variables.

Sample	Males	Females
Ac. self-efficacy	17.9 \pm 3.1	19.2 \pm 5.3
Critical thinking: open-mindedness	3.7 \pm 0.5	4.2 \pm 0.7
Critical thinking: systematicity/analycity	3.8 \pm 0.5	4 \pm 0.6
Critical thinking: truth seeking	3.4 \pm 0.6	3.7 \pm 1

Table 3: Linear regression analysis to determine the effect of academic self-efficacy on the dimensions of critical thinking.

	Adj. R2	F	P	b	t	P
Critical thinking: open-mindedness	0.122	63.47	1.36e-14			
Intercept				2.704	20.308	<2e-16
Ac. self-efficacy				0.058	7.967	1.35e-04
Critical thinking: systematicity/analyticity	.081	40.86	4.102e-10			
Intercept				2.912	21.276	<2e-16
Ac. self-efficacy				0.048	6.392	4.1e-10
Critical thinking: truth seeking	0.103	52.4	1.98E-12			
Intercept				2.306	15.381	<2e-16
Ac. self-efficacy				0.060	7.239	1.98e-12

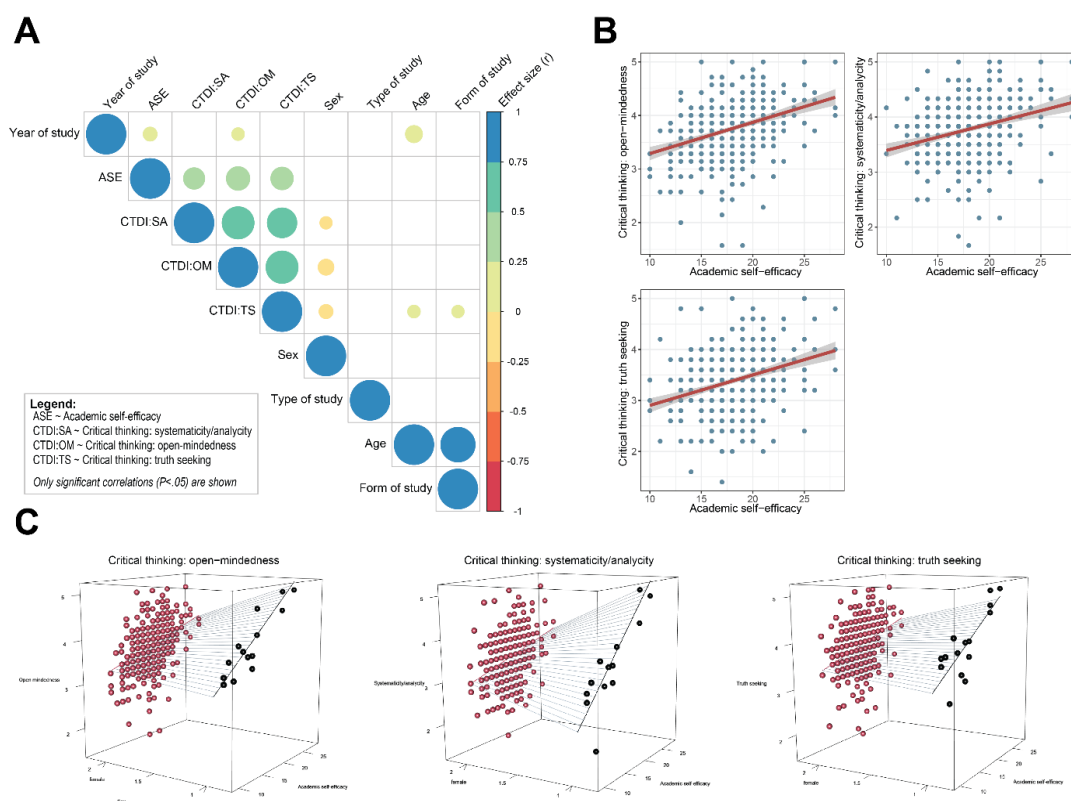


Fig. 1: The effect of academic self-efficacy on critical thinking. (A) the initial correlogram shows significant associations between the variables of interest. (B) Scatterplots with regression lines show the stand-alone effect of academic self-efficacy on individual dimensions of critical thinking. (C) 3D scatterplots show the interaction between sex and academic self-efficacy in affecting individual dimensions of critical thinking.

Table 4: Multiple linear regression to evaluate the effect of academic self-efficacy and gender on the dimensions of critical thinking.

	Adj. R2	F	P	b	t	P
Critical thinking: open-mindedness	0.150	27.58	<2.2e-16			
Intercept				1.952	4.399	1.36e-05
Ac. self-efficacy				0.116	5.173	3.49e-07
Sex				0.895	1.925	0.054
Ac. self-efficacy*Sex				-0.066	-2.790	0.006
Critical thinking: systematicity/analyticity	0.145	26.49	8.681e-16			
Intercept				0.643	1.298	0.195
Ac. self-efficacy				0.162	6.472	2.54e-10
Sex				1.895	3.650	2.94e-4
Ac. self-efficacy*Sex				-0.115	-4.375	1.51e-05
Critical thinking: truth seeking	0.090	15.91	7.626e-10			
Intercept				2.316	5.021	7.42e-07
Ac. self-efficacy				0.089	3.846	1.38e-04
Sex				0.694	1.437	0.152
Ac. self-efficacy*Sex				-0.047	-1.920	0.055

found (Table 4). The increase in the level of critical thinking in relation to academic self-efficacy was more pronounced for males compared with females (as illustrated in Figure 1C).

DISCUSSION

The objective of the study was to determine whether academic self-efficacy acted as a precondition for critical thinking in

university teacher training students. The results showed a relationship between self-efficacy and critical thinking; self-efficacy predicted all three factors of critical thinking. The trend of the relationships shown goes in the expected direction: higher academic self-efficacy is associated with better critical thinking ability. These findings are consistent with previous studies (Dehghani et al., 2011; Dwyer et al., 2017; Gloudemans et al., 2013; Hyytinen et al., 2018; S. L. Wang & Wu, 2008). To achieve a comprehensive perspective, it should be added that the explained variance of the monitored relationships reached lower values which means that self-efficacy is one but not the only one or the strongest predictor for critical thinking.

Two factors of critical thinking (open-mindedness and systematicity/analyticity) were influenced by the interaction effect between gender and the monitored variables; the increase in the level of critical thinking in relation to self-efficacy was more significant in men (cf. see Dehghani et al., 2011). There are more possible explanations. First of all, it is necessary to take into account the parameters of the research sample and the context of the Czech Republic. There are far fewer male teacher training students which makes their position relatively exclusive both in the course of study and practice. This can have a positive effect on their self-confidence and beliefs about their own abilities, which may consequently strengthen their critical thinking abilities. At the same time, male respondents in our sample were mainly students of more technical teacher training courses (for example information technology, mathematics, science) which by their nature require more analytical components of thinking, systematicity and accuracy (skills based more on critical thinking), while women tend to prefer languages as well as preschool and primary education. It can therefore be assumed that in these specific areas male students feel a greater degree of confidence and competence than their female counterparts. In this sense, our results are consistent with a study conducted by Huang (Huang, 2013). However, the low number of men, despite the relatively clear trend in the results (see Figure 1C), indicates the need to interpret the conclusions on gender differences with a certain degree of caution. Unfortunately, there are not enough relevant studies to compare our results in more detail. Previous studies either examined the effect of other factors such as field of study, length of work experience, time since graduation, etc. (see for example Gloudemans et al., 2013), or the effect of sex was analysed with respect to self-efficacy or critical thinking alone. Moreover, these results showed inconsistent findings about the effect of gender on one or the other construct (Artino & Stephens, 2009; Choi, 2005; Rudd, Baker, & Hoover, 2000; Walsh & Hardy, 1999; Wilson, Kickul, & Marlino, 2007).

CONCLUSION

In conclusion, this study is relatively convincing in suggesting that self-efficacy works as one of the predictors for critical

thinking in university students. These results have quite an extensive application framework not only in the academic environment but also, taking into account the background of the research sample, in the educational environment. Teacher training students, i.e. future teachers of all educational levels, are the bearers of education, thinking and culture of future generations. Their beliefs about their own abilities as well as possibilities of achieving goals and overcoming barriers is crucial to their future practice. Another important aspect is the extent to which they will be able to critically look at information in the public space and how (and with what internal confidence) they will be able to transfer these skills to their pupils and students.

SUGGESTION

Generally, a lack of confidence in one's abilities is a barrier to the development of critical thinking (Artino & Stephens, 2009). In the context of teacher training students, this finding is particularly important in relation to their generally lower self-efficacy rate compared with students of other disciplines, probably also in relation to the degree of development of critical thinking skills. It should be noted however that there are no relevant studies (Czech or international) supporting this statement. The statement is based especially on direct educational and counselling experience of the authors of this study with students of teacher training and other courses. In the context of the importance of critical thinking in the academic environment and the results of the present study, several recommendations can be formulated for the system of university education and the preparation of future teaching professionals. The recommendations primarily concern the systematic support of students' academic self-efficacy in order to develop their critical thinking, whether in the context of teaching by means of strengthening the argumentation and discussion component, greater emphasis on practical exercises and seminars, development of deep learning strategies, strengthening of positive feedback, accent on building scientific including motivated students, higher degree of students' participation in research projects, or in the context of counselling by means of supporting the achievement of specific academic goals which are sufficiently challenging for students as well as strengthening their motivation (Dale H. Schunk & Pajares, 2002, Gaebel & Zhang, 2018; Dale H. Schunk & Pajares, 2002).

LIMITATION

The present study has several limitations. Although the size of the sample is acceptable, its gender representation is highly unbalanced in favour of women, which could have affected the results in terms of gender-based differences. On the other hand, the proportion of respondents in terms of gender corresponds in principle to the actual distribution of students

enrolled in teacher training courses/faculties in the Czech Republic, where both elementary and secondary education is highly feminized. In addition, the research sample is limited to university students from a single faculty. A more diverse sample involving students from different faculties and disciplines could provide more general information on this issue. At the same time, the cross-sectional design of the study did not allow a direct assessment of the correlations between the monitored variables over time. Finally, only a proportion of students agreed to participate in the research (75.2%), which may indicate, albeit not significantly, a risk of possible data distortion. Finally, the results of self-assessment scales may be subject to distortion characteristic for this type of methods. The results of the study and their generalization should therefore be interpreted in the light of these limitations.

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