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EXPLORING ACADEMIC DISHONESTY PRACTICES AMONG SCIENCE EDUCATION UNIVERSITY STUDENTS

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Abstract. *The aim of this research was to explore e-dishonesty practices among science education undergraduates based on measurement models. The measuring tool was the Internet-triggered Academic Dishonesty Scale (IADS) comprised of ten items for the fraudulence construct and five items for the plagiarism construct as proposed by Akbulut et al. (2008), and another eight items as proposed by Karim, Zamzuri, and Nor (2009) for the construct of misuse in using information technologies by university students. A pilot sample of 125 valid responses and a test sample of 249 valid responses collected from university students in the Science Education program were subjects of factor analyses, non-parametric and invariance test methods. 16-item IADS scale was confirmed in a Romanian higher education context. A second-order factor (e-dishonesty), and three dimensions of first-order factors (plagiarism, fraudulence, and misuse in using information technologies (IT)) were validated. Plagiarism was the most important factor, followed by fraudulence and misuse in using IT. E-dishonesty practices dimensions not varied depending on the sociodemographic profile of undergraduates. The case study research provided a significant contribution to the understanding of ethical Internet behaviors and to generate an appropriate tool to measure the e-dishonesty practices among undergraduates learning science education subjects.*

Keywords: *academic dishonesty, bi-factor models, fraudulence in using IT, human behavior, plagiarism in using IT, misuse in using IT, Science Education, university students.*

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Introduction

The opportunities offered by the Internet for interpersonal communication, storage, and dissemination of information have brought many benefits to the university environment. The new technologies have changed the achievement of the teaching-learning process, the design and development of research projects, and the writing of scientific articles. However, with these positive changes, there has also emerged the reverse: cheating, fraud, piracy. The unethical use of the Internet became a severe concern to the academic environment. A wide range of behaviors of giving or receiving unauthorized assistance in a learning task in the university environment was a current debate topic (Kibler, 1993). The problem of plagiarism is still prevalent in universities, which is why specialists are trying to find new ways to combat this unwanted behavior (Cronan, Mullins, & Douglas, 2018). Many specialists have argued that cheating today is much handier because of the Internet, e-cheating being a current practice for more and more students (King, Guyette, & Piotrowski, 2009; Scanlon, 2003). With the help of the Internet, students can easily download or copy materials and use them to solve different work tasks without providing the author (Balbay & Kilis, 2019; Jereb et al., 2018; Ramzan, Munir, Siddique, & Asif, 2012). Increasing concerns about moral dilemmas on unethical behavior have emerged as the Internet is used more and more frequently in educational activities (Burnam & Kafai, 2001). The constant confrontation with the frequent changes of technology implies the formation of new attitudes towards the ethical issues of information technology (IT) use.

The concept of academic dishonesty is usually defined in its general sense but is particularized in relation to Internet practices. There is no consensus among researchers about what unethical behavior means. In a very general way, cheating was understood by King et al. (2009, p.4) "*as a transgression against academic integrity, which entails taking an unfair advantage that results in a misrepresentation of a student's ability and grasp of knowledge*." Furthermore, academic misconduct has been associated with "*antisocial behavior*" by Ternes, Babin, Woodworth, & Stephens (2019, p.75). The common point of all these definitions is the dimension of plagiarism. If computer ethics is one of the issues that emerged with computer technology (Namlu & Odabasi, 2007; Spinello & Tavani, 2001), Internet ethics might be considered as either a sub-component of computer ethics or a new area of ethics that emerged with the advance of the Internet. The rapid development and expansion of technology have led

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to the transition from academic dishonesty to „digital cheating" within educational institutions (Kauffman & Young, 2015; Ma, Wan, & Lu, 2008). Electronic dishonesty or academic dishonesty became a new term, as was presented in the studies conducted by Akbulut et al. (2008) or Namlu and Odabasi (2007). Odabasi et al. (2007) pointed out that the main feature that distinguishes academic dishonesty from traditional academic dishonesty is the ease of using Internet services for incorrect behaviors. Şendağ, Duran, and Fraser (2012) examined academic dishonesty in higher education from the perspective of personal and institutional factors.

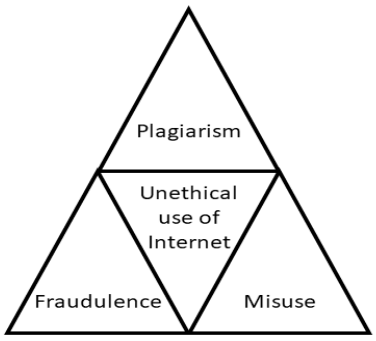
Forms of academic dishonesty have become more numerous, more challenging to control, and more insidious as a result of the use of new technologies. Negative phenomena driven by computer use in the academic world have been conceptualized with different meanings: internet-related misbehaviors (Freestone & Mitchell, 2004); Internet-triggered academic dishonesty or academic dishonesty (Abkulut et al., 2008); e-cheating and unethical Internet use (Karim et al., 2009); Internet-facilitated academic cheating, and unethical IT use (Chatterjee, Sarker, & Valacich, 2015). The main dimensions of the ethical use of the Internet are plagiarism, fraudulence, and misuse, according to the latest approaches (Karim et al., 2009). Koul, Clariana, Jitgarun, & Songsriwittaya (2009, p.506) defined plagiarism as a "*form of cheating and theft since in cases of plagiarism, one person takes credit for another person's intellectual work*." The form of academic misconduct under the conditions of the use of information technologies has acquired the name of "digital" or "cyber plagiarism" (Sutherland-Smith, 2005). The influence of the Internet on plagiarism has been proven in several studies because students who have already plagiarized have used the Internet as a medium to meet their plagiarism needs (Camara, Eng-Ziskin, Wimberley, Dabbour, & Lee, 2017; Eret & Ok, 2014; Sutherland-Smith, 2008). The main aim of most research in this area was to explore the factors that influence the unethical use of the Internet (Jereb et al., 2018; Uzun & Kilis, 2020). This research examined whether there is a relationship between two or more aspects of a situation or phenomenon. Accordingly, correlational research was used to explore the association between plagiarism, fraudulence, and misuse in using information technologies.

In the current research, the correlation between e-dishonesty dimensions was subject to analysis from the perspective of using the Internet. Chang, Shu, Lin, & Wang (2019) explored the mediation effect of Internet ethical judgment between Internet ethical self-efficacy (Efe, 2015) and Internet ethical behavior intention in the scenarios of internet plagiarism among high school students.

According to Akbulut et al. (2008), fraudulence is one of the dimensions of the unethical use of the Internet, along with plagiarism, falsification, delinquency, and unauthorized help. Austin and Brown (1999) appreciated that the fraudulence refers to downloading and using a complete work without making acknowledging or seeking permission. Davinson and Sillence (2010) believed that Internet fraud had increased more and more. The specific aspects of Internet fraudulence are the following: sabotaging other people's academic work, publishing other people's studies without the permission of the author, fabricating information, translating resources and claiming personal authorship (Akbulut et al., 2008; Karim et al., 2009).

The availability of access to information through the Internet determines the possibility of its misuse. The ease of misuse of the Internet (Odabasi et al., 2007) is one of the main factors affecting academic dishonesty. Karim et al. (2009) described the most relevant aspects regarding the misuse of the Internet in the academic environment, such as reading the e-mail or downloading materials during the courses, engaging in online discussions, or watching online movies during the practical activities (Köklükaya, 2015), etc. The correlation between the three dimensions shapes the triarchic model of the unethical use of the Internet (Figure 1).

Figure 1
The triarchic model of the unethical use of the Internet (academic dishonesty)



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Attitude can provide an excellent context for understanding the ethical issues and acceptance of technology in different contexts (Leonard & Cronan, 2005). In terms of structure, attitude (Szyjka, Mumba, & Wise, 2011) includes cognitive, affective, and conative elements that cause selective reporting to an object. Bommer, Gratto, Gravander, & Tuttle (1987) have developed an ethical decision-making model that could explain general ethical behavior. Based on this model, Leonard and Cronan (2005) proposed an ethical attitudinal model for computer use, in which attitude becomes a function of several environmental factors, such as societal environment, belief system, personal values, legal environment, business environment, moral obligation, and consequences.

Research Problem

The Internet has been extensively utilized in the academic environment as part of the processes and tools of learning within internal and external classroom environments. Its use, on the other hand, was made with a poor understanding of ethical issues, lack of ethical education and awareness, and lack of policies regulating its utilization for teaching, learning, and research (Baum, 2005). An alarming aspect is related to students' attitude toward e-cheating. As Şendağ et al. (2012) reported, the ease with which the Internet services can be accessed facilitates the engagement of students in committing acts of academic dishonesty. They are permissive, lax, reaching the phenomenon of tolerated deviance (Boncu, 2000; Teodorescu & Andrei, 2008). Students perceive that it is more acceptable to 'cheat' using information technology than it is to cheat without using it (Ma et al., 2008). Students' perception of cheating is of particular importance, as usually, the studies which assess students' dishonest behavior take the form of self-reporting. However, applied research on Computer ethics is scarce (Kim & Park, 2014). The Internet ethic or "Cyber ethic" with issues related to academic activities is not well discussed and investigated (Akbulut & Dönmez, 2018; Tavani, 2001). As Molnar, Kletke, and Chongwatpol (2008) highlighted, many studies were published further back before the Internet boom. Despite the fact that the problem of digital cheating is a priority, there are few studies focused on investigating the attitude of students and teachers towards the unethical use of the Internet in higher education. Referring to the Romanian university context, Ives et al. (2017) found that about 95 % of Romanian university students had reported having engaged in academically dishonest behaviors. Compared to other studies (Gallant, Van den Einde, Ouellette, & Lee, 2014; Kauffman & Young, 2015; LaDuke, 2013; Selwyn, 2008), which indicate an average rate of 70 %, this percentage was worryingly high. Other researchers have highlighted some predictors of academic dishonesty among Romanian university students, such as peer influences on a student's intent to cheat (Teodorescu & Andrei, 2009), the internal acceptability of the fraud and frequency behaviors with which they witnessed colleagues' fraud (Ives et al., 2017) carrying out activities unrelated with learning (Andrei, Teodorescu, Stancu, & Oancea, 2009). The results of the PISA surveys over the past ten years have consistently revealed that Romanian students are extremely demotivated at learning, which could be a trigger for fraud. Starting with the early grades, Romanian students use Internet resources for educational purposes, but without the slightest idea of intellectual property and plagiarism. The conduct of taking information from the Internet without specifying the source becomes a habit that students carry with them to college and university. Students do not acquire information on research ethics during their schooling, which makes their situation persist and aggravate in the academic environment because of the higher workload.

Research Focus

Clarifying the dimensions that contribute to combating the unethical use of the Internet is useful for understanding the problems that are caused by incorrect academic behaviors in a higher education environment. It is essential to explore the practices of university students towards the unethical use of the Internet to adopt preventive measures and to establish the accepted significance of academic integrity. The current research aims were to identify the factors and their reciprocal relations that influence the academic dishonesty practices of university students.

Research Model

This research was mainly interested in the latent construction of students' academic dishonesty practices towards the use of information technologies (IT) in a Romanian higher education context mirrored in three dimensions, corresponding respectively to plagiarism, fraudulence, and misuse. As a result of the literature studied, the main research question of this study was to explore the 2-order construct with three specific dimensions of order

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one, which are expressions of the practice perceived of academic dishonesty. Multidimensional and hierarchical representation of academic dishonesty practices among students through IT use was based mainly on theoretical arguments. The Internet-triggered Academic Dishonesty Scale (ITADS) developed by Akbulut et al. (2008) and Karim et al. (2009) in a Science Education study program context was used for this research.

Thus, the plagiarism dimension generally refers to "*intentionally or knowingly representing the word of another as one's own in any academic exercise*" (Burke, 1997, p. 22). Fraudulence consists of "*downloading and using a complete work without making acknowledgment or seeking permission*" (Şendağ et al., 2012, p. 850), and *"illegal software downloading or exposing the organization's systems to viruses, or 'malware' through surfing*" are some minor forms of ICT misuse (Weatherbee, 2010, pp. 36-37). Academic dishonesty practices in the context of higher education have been researched by many authors (Akbulut et al., 2008; LaDuke, 2013; Peled, Eshet, Barczyk, & Grinautski, 2019).

The modeling of dishonesty practices as a factor of the second-order allowed the estimation of the contribution of each dimension of the first order. These results are useful for measuring models that include this concept.

Research Questions

This research was mainly interested in the latent construction of students' academic dishonesty practices towards the use of information technologies (IT) in a Romanian higher education context mirrored in three dimensions, corresponding respectively to plagiarism, fraudulence, and misuse.

In order to complete the research aims, three specific research questions were expressed as follows:

Q1. What is the order of factors contributing to the hierarchical representation of academic dishonesty practices among Science Education university students?

Q2. Are there significant relations between the three specific dimensions of first-order, respectively, plagiarism, fraudulence, and misuse in using information technologies by Science Education university students?

Q3. Are there any variances regarding plagiarism, fraudulence, and misuse in using information technologies by Science Education university students between the participants with different age groups, education levels, and gender?

Research Methodology

General Background

An adapted questionnaire developed by Akbulut et al. (2008) and Karim et al. (2009) was used to obtain data. Romanian undergraduates and graduates in Sciences programs (pilot group) and Science Education program (test group) from two public universities („Alexandru Ioan Cuza" University of Iași and „Vasile Alecsandri" University of Bacau) who use the information technologies in teaching-learning activities represent the target population of this research. The research participants were students enrolled in the Science and Education Sciences domains, and they are preparing to become a pre-primary, primary, or secondary school teacher.

Sample

A non-random sampling technique was used to collect data in two Romanian public universities („Alexandru Ioan Cuza" University of Iași and „Vasile Alecsandri" University of Bacau) through an online questionnaire during 2nd Semester, 2018/2019 academic year. Across two stages of sampling, an exploratory factor analysis (EFA) was first conducted in a pilot test (N = 125) composed by Biology Science, Ecology Science and Engineering Science students who are preparing to become a secondary school teacher from both universities to investigate constructs in the survey tool. Next, the constructs of the survey tool were confirmed by confirmatory factor analysis (CFA) using a second sample (N = 249) students from both universities in the same period of 2018/2019 academic year. The sampling structure for the second stage was comprised of students enrolled in the Education Sciences programs who are preparing to become a pre-primary and primary school teacher. This sampling structure was appreciated as entirely appropriate for exploring e-dishonesty practices among science education university students since this study program that has been the subject of the research from both universities has about 900 enrolled students.

Four hundred sixty university students were recruited to take part in the survey from two public universities from the north-eastern region of Romania in the 2nd Semester, 2018/2019 academic year. The response rate of

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volunteers was approximately 83 %. A total of 374 valid responses were retained for the research by excluding outliers. Among the 249 valid respondents of the second stage, 92.4 % were female, and 7.6 % were male. Also, 41.8 % study at the Bachelor level, 58.2 % at the Master level, 73.5 % are students up to 30 years old, and 26.5 % are students over the age of 30.

Descriptive Statistics of Research Participants

The population of the first stage of sampling corresponding to pilot sample consisted of 125 students enrolled in Science programs (Biology Science, Ecology Science) from the "Vasile Alecsandri" University of Bacau, and the population of the second stage of sampling corresponding to test sample consisted of 249 students enrolled on Science Education program from both universities.

The descriptive statistics of all data sets are presented in Table 1.

Table 1
Results of descriptive statistical analysis of the study samples

Variable	*n* (%)	Variable	*n* (%)
Study/Discipline		Age group	
Pilot/ *Biology Science, Ecology Science, and Engineering Science*	125 (33.4)	21-30	294 (78.3)
Test/*Science Education*	249 (66.6)	+30	80 (21.7)
Gender		Degree	
Males	44 (11.8)	Bachelor	152 (40.6)
Females	330 (88.2)	Master	222 (59.4)
University			
Vasile Alecsandri	270 (72)		
Alexandru Ioan Cuza	104 (28)		

Instrument

Students' e-dishonesty practices were measured through the Internet-triggered Academic Dishonesty Scale (ITADS) developed by Akbulut et al. (2008) and Karim et al. (2009). The 26 items were used to measure the fraudulence (e.g., selling an individual project on the Internet), plagiarism (e.g., using the Internet to copy others' work without permission), falsification, and misuse (e.g., watching online video/movie during lab-based lectures). All the items were measured using the 7-point Likert scale comprised of 1 –Strongly disagree, 2 – Disagree, 3 – Somewhat disagree, 4 – Neutral, 5 – Somewhat agree, 6 – Agree and 7 – Strongly agree.

Data Analysis

In the first stage, the raw data were examined using screening methods of IBM SPSS Statistics version 23 to identify outliers, normality of data, and descriptive statistics. Also, the Principal Axis Factor method with oblique rotation was used for the exploratory step of data.

The proposed research model was tested using the Amos software free version 26, a powerful multivariate analysis support. A Confirmatory Factor Analysis was performed for all data sets to investigate the overall construct validity and to compare model parameters and fit indices across the clustering of independent variables (Chuang, Weng, & Huang, 2015).

The same population can be differentiated by gender, level of study, and age group. In order to investigate the differences generated by sociodemographic factors, it was necessary to verify the invariance of the measure of the first-order and the second-order IADS models for each category using multigroup measurement invariance. Three nested models were tested for each of the first-order and the second-order CFA models. For this, the measure-

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ment invariance models were examined. The assessments for configural, metric, and scalar invariance checked the scale configuration (no constraint), the metric invariance (saturation of the items in factors is constrained), and the scalar invariance (intercept values were constrained for each item separately) (Sarbescu, 2014). The scaled χ^2 model difference test (χ2 diff) was used to assess the measure of goodness of fit between nested measurement invariance models employed in this study. Statistically nonsignificant χ^2 diff between nested models ($p > .05$) supports measurement invariance (Harry & Waring, 2019). The effects of the sociodemographic variables on correlations between IADS scale dimensions were also explored.

The total score corresponding to all dimensions of the IADS scale is also applied to assess academic dishonesty practices (Alothman, Robertson, & Michaelson, 2017). The score of each scale was achieved by summing up the arithmetic mean of the standardized scores of each response, and the final score of the scale was achieved by summing the scores of the three dimensions. After checking the invariance of the measurement scale, the Mann-Whitney *U* test was used to test if the three dimensions of the measurement scale, but also the scale as a whole, depend on the variable categories (Lazar, 2019).

Research Results

Exploratory Factor Analysis and Internal Consistency Analysis

The overall value of Cronbach's alpha was very high (.945), which indicated the excellent reliability of the tool. The results of the EFA (Principal Axis Factoring with Promax rotation). The results of the EFA (Principal Axis Factoring with Promax rotation) analysis conducted on the pilot sample of 125 respondents indicated the presence of 3 dimensions of the instrument: fraud, misuse, and plagiarism. Each of the three factors was also very reliable, given that the values of Cronbach alpha were: Fraudulence (.94), Misuse (.93), and Plagiarism (.92). As a next step, we conducted an exploratory factor analysis (EFA) with a sample pilot of 125 of Biology Science and Engineering Science university students. This sample was homogeneous, the results of the Jonckheere-Terpstra test confirming the absence of a significant difference in the scores of the three dimensions. The EFA analysis extracted the three fundamental factors using the Eigenvalues criterion (eigenvalue rule-greater than 1), which explained 71.760 % of the total variation. The first factor appears saturated in items that assess Fraudulence and is also the factor that explains most of the total variance (39.40 %). The second factor is saturated in items that evaluate Misuse and explain 10.73 % of the total variance. The third factor is saturated in items that evaluate Plagiarism and explain 5.60 % of the total variance (Annex 1).

In conclusion, the results of the EFA analysis supported the predefined structure of the three dimensions, namely fraudulence, misuse, and plagiarism. It was noted that all rotated factor loads associated with theoretical constructions have values higher than .50 (Annex 1) (Field, 2000).

Confirmatory Factor Analysis and Overall Construct Validity

This structure obtained during the EFA analysis was further validated by confirmatory factor analysis (CFA) using the Amos 17 software with a separate sample ($n = 249$).

Testing of the first-order and the second-order CFA models and overall construct validity investigated whether the hypothetical structure provides a good match for data.

During the tests to verify the validity of the structure of the first-order CFA model, an infringement of the discriminatory validity was observed in the case of the Fraudulence factor. Consequently, the items were removed, and the validity tests have been rerun. Representatives of the Fraudulence dimension, which fulfill all the validation criteria (Saloviita, 2015; Scherer, Siddiq, & Tondeur, 2019) are only three items: Publication of other people's studies/works on the Internet, without the author's permission, issuing the claim to use bibliographic materials and references that have not actually been used and translating resources from the Internet and claiming the right to use them as authors. Using these three representative items of Fraudulence and all other items for measurements of misuse and plagiarism, the results of the construction validation analysis for the first-order CFA model (measurement model) comply with all required criteria (Table 2).

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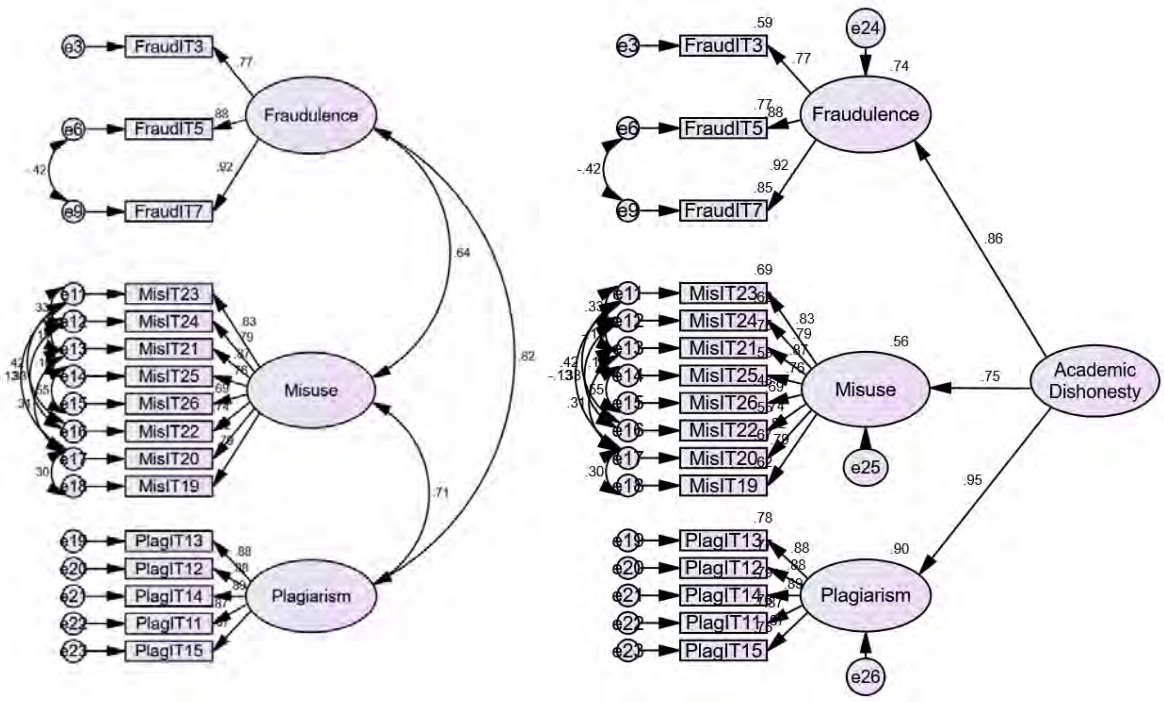
Table 2
Construct validity indices (convergent and discriminant validity) for the first-order CFA model (measurement model)

	CR	AVE	MSV	MaxR(H)	Misuse	Fraudulence	Plagiarism
Misuse	.929	.621	.504	.934	.788		
Fraudulence	.893	.737	.667	.912	.642	.858	
Plagiarism	.944	.770	.667	.944	.710	.817	.877

Note: chi-squared/df < 3; Tucker-Lewis index TLI (criterion > .90); comparative fit index CFI (criterion > .90); root mean square error of approximation RMSEA (criterion < .08); Standardized Root Mean Squared Residual SRMR (criterion < .08)

Figure 2
a-b. a. Outputs of the first-order CFA model and b. Outputs of the second-order CFA model (n = 249/test stage corresponding to the second sample)



Note: The codes of items are presented in Annex 1

The first-order CFA model has been drawn to test the relationships between the three dimensions and the 16 associate items. The results of the first-order CFA model (Figure 2a) validated the appropriate fit of the model (χ^2/df = 1.460, RMSEA = .043, CFI = .988, SRMR = .0313).

The testing of the second-order CFA model was carried out using a second-order (academic dishonesty practices) factor and three order-one factors (Figure 2b). The quality of the second-order CFA model was appropriate because all indices meet the threshold values of the criteria, the values of the indices of the second-order CFA model are similar to the first-order CFA model. So, the results of the second-order CFA model validated the appropriate fit of the model (Figure 2b), thus creating the necessary framework for further analysis (Balog, 2011).

In terms of quality indices, any of the first-order CFA model and second-order CFA model can be accepted for use. The association between the second-order factor and the first-order factors was measured using standardized

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regression coefficients (γ) (Balog, 2015) which have values (Figure 2b) greater than .75 and are statistically significant ($p < .001$), thereby demonstrating the convergent validity of the specified model (Balog, 2011).

The results showed that Plagiarism is the most important factor, followed by Fraudulence, and Misuse in using IT. The second-order model explains 90 % of the variation in Plagiarism, 74 % in Fraudulence, and 51 % in Misuse in using IT (Figure 2b) (*Research Question Q1*).

Measurement Invariance Testing

Grouping variables involved the gender (1 = female, 2 = male), the level of degree (coded as 1 = Bachelor, 2 = Master), the age group (coded as 1 = under 30 years old, 2 = over 30 years old), and. The measurement invariance testing was run for each category of the independent variable to explore possible subgroup variances among the first-order CFA model. The results of three nested models for the first-order CFA model are presented in Table 3. All tested models displayed configural, metric, and scalar invariance between males and females, students enrolled in Bachelor and Master programs, and students with ages up to 30 and over (Table 3).

Table 3
Main test indicators of the first-order CFA model

Tested Models	χ^2	*df*	*DELTA*	χ^2/df	RMSE*A*	*CFI*	*DCFI*	*SRMR*
Configural invariance M2	379.772[a]	182[a]	-	2.087[a]	.066[a]	.946[a]	-	.0308[a]
	257.326[b]	182[a]	-	1.414[a]	.041[a]	.979[a]	-	.0425[a]
	294.127[c]	182[a]	-	1.616[a]	.050[a]	.969[a]	-	.0344[a]
Metric invariance M3	394.152[a]	198[a]	14.38 (16) *ns*	1.991[a]	.063[a]	.947[a]	.001 *ns*	.0316[a]
	276.673[b]	198[a]	19.35 (16) *ns*	1.397[a]	.040[a]	.978[a]	.001 *ns*	.0496[a]
	318.354[c]	198[a]	24.23 (16) *ns*	1.608[a]	.050[a]	.967[a]	.002 *ns*	.0350[a]
Scalar invariance M4	410.977[a]	211[a]	16.83 (26) ns	1.984[a]	.062[a]	.946[a]	.001 *ns*	.0314[a]
	302.935[b]	211[a]	26.83 (13) ***	1.436[a]	.066[a]	.974[a]	.004 *ns*	.0477[a]
	355.401[c]	211[a]	37.05 (13) **	1.684[a]	.053[a]	.960[a]	.007 *ns*	.0344[a]

*Note: ***p < .001; ** p < .05; ns = non- significant; chi-squared (χ^2)/df < 3; comparative fit index CFI (criterion > .90); root mean square error of approximation RMSEA (criterion < .08); Standardized Root Mean Squared Residual SRMR (criterion < .08) (Lee, 2019; Park, 2019); a. gender, b. degree level, c. age group;*

Inter-dimension Correlations

The association between two latent variables was measured by Pearson's correlation coefficient (R^2). The indices of the first-order CFA model are detailed within each cluster to compare model parameters and fit indices across groups. Excessively high correlations (> .85) (Reis, Laguardia, Barros, Andreoli, & Martins, 2019) were not obtained between the dimensions of the first-order CFA model corresponding to all data sets (Table 4). However, excessively high correlations were obtained in two situations: between Plagiarism and Fraudulence in the case of students enrolled in Bachelor programs and the case of students with ages more than 30 years (Table 4).

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Table 4
Summary results of Correlation coefficients, and the first-order CFA model fit indices; general and subgroup analyses (n = 249/ test stage)

Group/Subgroup		Correlations between the dimensions	R^2
General (all data sets)		Fraudulence-Misuse	.64***
		Plagiarism-Fraudulence	.82***
		Misuse-Plagiarism	.71***
Gender	Female	Fraudulence-Misuse	.64***
		Plagiarism-Fraudulence	.83***
		Misuse-Plagiarism	.72***
	Male	Fraudulence-Misuse	.64***
		Plagiarism-Fraudulence	.82***
		Misuse-Plagiarism	.71***
Degree	Bachelor	Fraudulence-Misuse	.65***
		Plagiarism-Fraudulence	.90***
		Misuse-Plagiarism	.72***
	Master	Fraudulence-Misuse	.63***
		Plagiarism-Fraudulence	.76***
		Misuse-Plagiarism	.71***
Age group	21-30	Fraudulence-Misuse	.62***
		Plagiarism-Fraudulence	.80***
		Misuse-Plagiarism	.70***
	+30	Fraudulence-Misuse	.63***
		Plagiarism-Fraudulence	.86***
		Misuse-Plagiarism	.71***

*Note: ***p < .001; chi-squared/df < 3; Tucker-Lewis index TLI (criterion > .90) ; comparative fit index CFI (criterion > .90); root mean square error of approximation RMSEA (criterion < .08); Standardized Root Mean Squared Residual SRMR (criterion < .08) (Park, 2019, Lee, 2019)*

The main aims of subgroup analyses were to explore the generalizability of the results regarding the first-order CFA model fit indices. For each of the subgroups examined in this research stage, the first-order CFA model fit indices together with Pearson correlation coefficients (R^2) were measured. The outputs indicated significant relations between the three specific dimensions of order one, respectively, plagiarism, fraudulence, and misuse in using information technologies by Science Education university students (*Research Question Q2*).

Results on the Mann-Whitney U Test

It was necessary to establish a strong measurement invariance of the measures if the groups were compared based on their scores (Barrera, García, & Moreno, 2014). Since this invariant condition of the measurement model has been demonstrated, this next stage can be completed.

So, the differences depending on the age group, education levels, and gender regarding academic dishonesty practices by Science Education university students were tested using the Mann-Whitney *U* Test. The score corresponding to the 16-item scale resulting from the validity of the structure of the first-order CFA model was used to perform the Mann-Whitney *U* test, as shows in Table 4. It is observed that males report a higher level of academic dishonesty practices than females, and master's students report a higher level of academic dishonesty practices than those enrolled in a bachelor's degree program. The students younger than or equal to 30 years report a higher level of academic dishonesty practices than older students enrolled in formal education.

However, all calculated differences are not statistically significant (Table 5) (*Research Question Q3*).

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Table 5
Mann-Whitney U test results (a: Ranks and b: Test statistics)

Category variables		*N*	Mean Rank	Sum of Ranks
Gender	Female	230	124.03	28526.50
	Male	19	136.76	2598.50
Level of study	License	104	122.48	12738.00
	Master	145	126.81	18387.00
Age group	Less than or equal to 30 years	183	130.22	23830.00
	More than 30 years	66	110.53	7295.00

a Ranks

Category variables	Test	Score Ethics
Gender	Mann-Whitney *U*	1961.500
	Wilcoxon *W*	28526.500
	Z	-.741
	Asymp. Sig. (2-tailed)	.459
Level of study	Mann-Whitney *U*	7278.000
	Wilcoxon *W*	12738.000
	Z	-.467
	Asymp. Sig. (2-tailed)	.640
Age group	Mann-Whitney *U*	5084.000
	Wilcoxon *W*	7295.000
	Z	-1.904
	Asymp. Sig. (2-tailed)	.057

b Test statistics

Discussion

One of the significant implications of this study was the need for higher education institutions to review their policies on three main dimensions of academic dishonesty: fraudulence, misuse, and plagiarism (Eret & Ok, 2014). For this purpose, validated tools in terms of content and structure are needed to measure the attitude towards them correctly.

The main reason that supports the need for external validation of the Internet-triggered Academic Dishonesty Scale (ITADS) tool was that the attitude is generally culturally shaped (Orlikowski, 2000). As a result, special attention should be paid to the quality of the tools used in a culture different from the one in which they were created.

Therefore, the understanding of the attitude towards the unethical use of the internet is becoming a relevant issue in the current educational context of Romania, marked by an explosive growth in the use of the Internet among university students in general, and in particular, among the students enrolled in the study program of Education Sciences, those who will be future teachers.

From the perspective of these arguments, the Internet-triggered Academic Dishonesty Scale (ITADS) published by Akbulut et al. (2008) and Karim et al. (2009) was adapted in Romanian. Subsequently, the structural fidelity and validity indices of the adapted instrument were tested using a measurement model comprising four correlated constructs and 26 reflective items (Balog, 2011). This type of analysis was particularly necessary because the authors of the official scale in English do not show evident data about the structure validity of the instrument. Generally, a model can be used to measure specific parameters only under conditions it has convergent and discriminant validity (Lazar, 2019).

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Briefly, the primary purpose of this study was to explore the ethical attitude towards the Internet with one pilot sample, including Romanian university students in Sciences program studies and another testing sample comprising Romanian university students in Science Education program study. Specific objectives were to verify the psychometric qualities and the factorial invariance in a Romanian sample of the ITADS scale by gender, age groups (young up to 30 years and middle-aged over 30 years), and level of education (Bachelor and Master).

Exploratory factor analysis was used to check the configuration factors for the translated and adapted version of the 26-items ITADS scale. The model validated by exploratory factor analysis differs in some issues from the original Internet-triggered Academic dishonesty Scale model published by Akbulut et al. (2008) and Karim et al. (2009). Thus, the model does not include the factor "Falsification" as the items associated with this factor had loads on factor "Plagiarism" with values below the critical value of .5 (Field, 2000). Seven items were suppressed from "Fraudulence" after checking out modification indices and standardized residuals (Saloviita, 2015; Lazar, 2019). The possible arguments for this situation consist of the ambiguous character of the items characterizing the factor "Falsification". As a result, students probably interpreted these items in a similar way to plagiarism.

Multidimensional and hierarchical representation was justified by theoretical arguments, thus demonstrating that fraudulence, misuse, and plagiarism were distinct manifestations of the practices towards the unethical use of the internet by undergraduates' students. In general, the university students express such behavior both globally and at the level of each dimension.

All three dimensions modeled as first-order factors achieved an optimal level of internal consistency ($\alpha > .93$), values much higher than those obtained by Akbulut et al. (2008) and Karim et al. (2009). In conclusion, unlike the original scale, in the case of the Romanian version, the Falsification factor did not load the measuring scale of the attitude towards the unethical use of the Internet.

The literature contains numerous studies on testing the behavior against academic dishonesty, but very few used identical or similar scales. Only several studies use items developed by Akbulut et al. (2008). A selective list of studies in the field of academic dishonesty is presented in Annex 2, highlighting the dimensions, participants, psychometric properties, and main results.

Annex 2 highlights the novelties of this research. The measurement model of academic dishonesty with three above mentioned factors has been strongly validated as structure. Moreover, this study complements the results obtained by Şendağ et al. (2012, p. 850), who found that "*social and educational fields admitted less academic dishonesty compared to engineering and the physical sciences*" and suggested the need for in-depth studies.

The first-order CFA model (measurement model) consisting only of the three correlated constructs and 16 reflective items was used to test the conformity of the model (Figure 2). It must be underlined that the "Fraudulence" construct contains only three items that support convergent and discriminatory validation as opposed to the 11 items proposed by Akbulut et al. (2008) and Karim et al. (2009). The results obtained from the confirmatory analysis indicate a very good level of quality of the measurement model ($\chi^2 = 132.866$, df = 91, p = .03; TLI = .984, CFI = .988, RMSEA = .043, SRMR = .0313). This result is explained by the fact that in this research, in addition to the previous ones, the convergent and discriminant validity of items was tested.

The quality of the second-order CFA model was similar to the first-order CFA model since the values of the indices of the second-order CFA model were the same with the first-order CFA model. Moreover, the advantage of the second-order CFA model consisted of the possibility of estimating the contribution of each of the first-order factors to the model. The outputs indicated that Plagiarism has the largest contribution to academic dishonesty practices while misuse in using IT has the smallest contribution.

The correlation coefficients reported in Table 3 respond to the second research question. Results showed higher levels of significant positive correlations of all components of academic dishonesty. The correlation analyses can only measure whether a relationship exists between two variables (Hung, Bounsanga, & Voss 2018), but they can be compared as intensities of links between variables. Generally, these relationships were what we would have supposed. The most reliable connection between plagiarism and fraudulence was established. These findings showed that taking precautionary measures to reduce fraud, probably the plagiarism will be less frequent. While no comparable data can be found from previous research, these results cannot be compared with past research (Karim et al., 2009). However, the relationships between plagiarism, fraudulence, and misuse as variables were much stronger than those between factors of academic dishonesty scale (Bashir & Bala 2018), as can be remarked in Annex 2.

The analysis of invariance by gender, age groups, and level of studies revealed favorable results, confirming the invariance for all three category variables. The configured invariance of the 16-items ITADS scale measurement

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model was validated by the results of CFA analyses. These findings allowed us to state that the sample measures the same construct for both men and women. Moreover, sample measurements do not depend on the two age or study level categories. Also, based on these results, we can conclude that 16 items of the original scale, which has been identified in Turkey and subsequently validated in Malaysia and the USA, is also valid in Romania, for both sexes, by age group and level of education. Thus, we can say that the differences between males and females, by age group and level of education relating to unethical Internet use can be attributed only to differences at the level of the academic dishonesty features, and no other factors.

In the end, the strengths and limitations of this study were mentioned. The present study tested the construct validity of the ITADS tool in a Romanian context. Additionally, the invariance of this tool for students in Science Education by gender, age, and level of education was tested. These two facets constituted the real strong points of the present research. According to the results, the measurement model of the Internet-triggered Academic Dishonesty Scale applied in Romania showed a very good match with the data for 16-items and had an optimal level of internal consistency, thus supporting its use in the future. The different results are justified due to the different contexts and the different target groups in which the study was conducted.

The central limitation of this study lies in the fact that potential participants were not recruited from a randomized control trial. These aspects can be corrected, and therefore in the future, we aim to improve the selection procedures. Moreover, we intend to test more structured models in order to explore the links between other predictors of academic dishonesty latent factors.

Conclusions and Implications

This research has contributed to the expansion of measuring instruments in the field of academic evaluation dishonesty practices in the online environment. The academic size of dishonesty practices was conceptualized for the first time into Romanian higher education context from the perspective of the learners as a multidimensional and hierarchical construct of the second-order factor, in which first-order factors correspond to the specific dimensions.

Mainly, this research has proposed to explore the order of factors contributing to the hierarchical representation of academic dishonesty practices among Science Education university students, if the relationship between the three specific dimensions of the first-order model were statistically significant and if the differences depending on the age group, education levels, and gender regarding academic dishonesty practices by Science Education university students were statistically significant.

The research results were both theoretical and practical. From a theoretical point of view, it can be mentioned the contribution of the authors to the development of two measurement models, the first one validated as structure, and the second one validated as convergence. Based on the 16-item ITADS scale corresponding to the first-order CFA model, the research on the relations between plagiarism, fraudulence, and misuse in using information technologies by Science Education university students has revealed that a strong correlation across all grouping variables occurs.

Moreover, no significant variation of correlation coefficients and CFA model fit indices across study samples occurred, so the 16-item ITADS scale can be useful to examine the unethical students' practices regardless of the category of independent variable investigated. These results have at least two consequences: first, a small scale measuring ethical aspects in using information technologies by Science Education university students was obtained. Secondly, this reduced scale can be applied to students regardless of their age, gender, and level of study.

The research was expected to provide a significant contribution to the understanding of ethical Internet behaviors and in generating appropriate mechanisms for education and awareness of the issues. Educators and computer professionals alike play essential roles in shaping and determining how computers and the Internet affect social lives and interactions among its users. Therefore, the knowledge of appropriate computer behaviors should be well-developed and identified through research and discussions, and further accommodated in the teaching of ethics to better equip them, as well as the general users, with the right moral values pertaining to its use.

Not all universities have compulsory computer ethics courses, and many syllabuses in computer ethics do not include the proper use of the Internet among general users as a basis for the design and development of various information and IT policies. For these reasons, the current research can be appreciated as a useful contribution to the understanding of academic dishonesty, a phenomenon with an unpredictable and definitely damaging evolution in the higher education all over the world, especially in the case of the education science program that prepares future teachers of tomorrow's generation.

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Statement

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Annex 1

Results of exploratory factor analysis and internal consistency analysis

EFA Pattern Matrixa

Items developed by Karim 2009	Code of Items	Factor		
		1	2	3
" Adding the names of non-contributing people as authors"	FraudIT4	.823		
"Slicing an Internet resource in a way that opposes the original document and favors personal point of view"	FraudIT9	.763		
"Publishing other people's studies on the Internet without the permission of the author"	FraudIT3	.752		
"Deliberately providing wrong references"	FraudIT8	.740		
"Sabotaging other people academic work through Internet"	FraudIT1	.716		
"Claiming to have used materials and references that were not actually used"	FraudIT5	.711		
"Claiming to have conducted a research that was not conducted"	FraudIT6	.695		
"Selling an individual project on the Internet	FraudIT2	.648		
"Translating Internet resources and claiming personal authorship"	FraudIT7	.593		
"Slicing an Internet resource in a way that opposes the original document and favors personal point of view"	FraudIT10	.402		
"Playing online games during lab-based lectures"	MisIT23		.843	
"Updating blog contents during lab-based lectures"	MisIT24		.841	
"Engage in online chatting during lab-based lectures"	MisIT21		.825	
"Surfing community portals (Friendster, My Space, Facebook, and etc.)"	MisIT25		.799	

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EFA Pattern Matrixa				
Items developed by Karim 2009	Code of Items	Factor		
		1	2	3
"Using the Internet for purposes other than learning and completing assignments at the general labs"	MisIT26		.769	
"Watching online video/movie during lab-based lectures"	MisIT22		.760	
"Downloading files during lectures"	MisIT20		.744	
"Reading e-mail during lectures/ in classroom"	MisIT19		.714	
"Copy and paste several resources found on the Internet and using in an assignment without acknowledging the authors"	PlagIT13			.955
"Using the important parts of other people's works on Internet without acknowledging the author"	PlagIT12			.789
"Using Internet to copy others' work without permission"	PlagIT14			.752
"Using other people's complete works on Internet for personal assignments without acknowledging the author	PlagIT11			.739
"Using Internet quotations in personal assignments without a quotation mark as one's own"	PlagIT15			.617
Cronbach's α		0.942	0.935	0.943

Extraction Method: Principal Axis Factoring. Rotation Method: Promax with Kaiser Normalization. a. Rotation converged in 5 iterations.

Annex 2

Selection of instruments to measure unethical Internet use by university students confirmed in the last 10 years

Instrument	Dimensions	Participants	Internal consistency or/and construct validity	Results	References
Internet-Triggered Academic Dishonesty Scale (ITADS)	Fraudulence Plagiarism Falsification Delinquency Unauthorized help	349 university students enrolled in the Faculty of Education, Turkey	Cronbach's Alpha =.925	The order of factors importance is: Fraudulence, Plagiarism, Falsification, Delinquency, Unauthorized help.	Akbulut et al., 2008
Internet-Triggered Academic Dishonesty Scale (ITADS)	Fraudulence Plagiarism Falsification Misuse	252 students enrolled in three different academic faculties from a public university in Malaysia	Cronbach's Alpha varies from .797 (Misuse) to .88 (Fraudulence)	No significant difference between university students of different faculties in terms of fraudulence, plagiarism, and falsification, but a significant difference is in terms of misuse of Internet facilities.	Karim et al., 2009
An adapted form of Internet-Triggered Academic Dishonesty Scale (ITADS) published by Akbulut et al. (2008)	Fraudulence, Plagiarism, Falsification, Delinquency, Unauthorized help	1153 students registered in a public university in South-eastern Michigan, United States of America	Cronbach's Alpha =.917	Primary field of study influenced students' e-dishonesty practices; social and educational fields stated less e-dishonesty compared to engineering and the physical sciences.	Șendag et al., 2012

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Instrument	Dimensions	Participants	Internal consistency or/and construct validity	Results	References
Academic Dishonesty Scale (ADS)	Cheating in examination, Plagiarism, Outside help, Prior cheating, Falsification Lying about academic assignments	900 undergraduate university students in Kashmir province of Jammu and Kashmir from India	Cronbach's Alpha =.831; Strong evidence for the construct validity of the scale	Inter-correlation between factors of academic dishonesty scale ranges from 0.125 (Falsification and Prior cheating) to 0.441 (Lying about Academic Assignments and Plagiarism)	Bashir & Bala 2018
Digital piracy scale	Attitudes; Current piracy; Previous piracy; Prosecution risk	465 undergraduate students from Turkey	Cronbach's Alpha varies from .75 (Attitude) to .91 (Current piracy); Strong evidence for the construct validity of the scale	Prosecution risk correlated negatively with previous piracy, attitudes, and current piracy; attitudes, current piracy and previous piracy were correlated positively	Akbulut & Dönmez 2018
Academic Integrity Inventory	Misconduct, Plagiarism, Cheating	2475 students in six different academic institutes from United States of America and North of Israel	Cronbach's Alpha =.91;	Academic Dishonesty AD determinants should be re-evaluated as online courses are not a predominant factor in AD prediction	Peled, Eshet, Barczyk & Grinautski 2019
An adapted form of Internet-Triggered Academic Dishonesty Scale (ITADS) published by Akbulut et al. 2008 apud Karim et al. 2009	Fraudulence Plagiarism Misuse	375 undergraduates' students in Science and Education Science from Romania	Cronbach's Alpha varies from .935 (Misuse) to .943 (Plagiarism); Strong evidence for the construct validity of the scale	The order of factors importance is: Fraudulence, Misuse, Plagiarism; Inter-correlation between factors of academic dishonesty scale ranges from 0.64 (Fraudulence and Misuse) to 0.82 (Plagiarism and Fraudulence); Invariance of the shape of the measuring model on categorical independent variables: gender, degree and age-grouped	Present study

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