ROMANIAN STUDENTS' INVOLVEMENT, AS POTENTIAL DRIVERS OF CHANGE, INTO ACADEMICALLY R&D - RELATED ACTIVITIES

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Abstract
In the past 20 years, knowledge-intensive business services (KIBS), like research and development (R&D), have widely spread in American, European and even Asian countries. Such services exert a considerable amount of influence over the process of innovation in the context of a knowledge-based economy. As the EU failed to achieve its main goal of transforming the EU economy into one of the most dynamic and knowledge-based economies of the world and the discrepancies between countries have expanded mostly due to a dearth of qualified or experienced employees, this study will try to apply and develop a model that might contribute to boost their motivation towards getting involved into knowledge-based activities, such as R&D. Romania is one of the EU countries facing an enormous shortage of qualified and motivated personnel able to master and evaluate specialized information and model it into suitable inputs. Being actively involved at an early stage of a career, even as a student apprentice, could represent the first step into creating a new generation of highly motivated and skilled specialists. This paper represents an extension to a prior pilot-study regarding students motivation towards manifesting interest regarding R&D-related activities, but is analyzing the situation on a larger scale, with respondents having a various academic background, studying from technical to social sciences majors. Therefore, we intend to find a solution that will change Bucharest students' perceptions regarding their involvement into knowledge-based activities, aiming at preparing them as future professionals.

Keywords
R&D, KIBS, innovation, human capital.

JEL Classification
O31, J24, D83, E24, P46.

Introduction

Encouraging students' participation into R&D-related activities and discovering the main drivers of becoming active learners and future knowledge-oriented professionals (Miles et al., 1995) represents an important goal for Romania's future business innovations environment and development in the context of a dynamic knowledge-based EU economy. This goal has become a real challenge for the public R&D field, especially universities, but also for knowledge-intensive companies who perform R&D activities that support and enhance the growth of both secondary and tertiary sectors and business models (EMCC,

2006). EU is far from achieving its 3% aim of R&D intensity (European Commission, 2010) by 2020 and one of the main reasons is the lack of innovation efforts and capable personnel. Therefore, the present study aimed at analyzing Romanian students' motivation and interests regarding R&D-related activities and the importance given to such activities towards the brighter innovation future of the Romanian knowledge-based economy. In a KIBS firm, rarely can be found professionals who, as a daily activity perform R&D-related tasks, and if they consider such activities knowledge-oriented, they usually represent only consulting ones (Miles, 2007). A KIBS company could be able to fill in the existing dearth of R&D knowledge in a client-firm by augmenting the existing activities (Doloreux & Shearmur, 2012) and transforming it in a more competitive one (Czarnitzki & Spielkamp, 2003). In order to fulfill these needs, a KIBS firm has to train its personnel or, even better, to hire already schooled graduates. Hence, training and motivation might need to start from an early age, by getting involved in R&D-related activities (Miles, 2007) such as participation to competitions, conferences and other stimulating activities.

Regarding students' motivation towards getting involved into R&D-related activities, we started our research based on Tuan's et al. (2005a) SMTSL designed questionnaire which initially proposed six variables (achievement goals, performance goals, learning values, learning environment and self-efficacy) that influence motivation towards science learning in high schools. This instrument was applied and adapted by many other researches, in the same field or related ones, and came with similar or even different results (e.g. Velayutham et al. 2011; Singh, Misra & Srivastava, 2017). In 1998, Mintzes et al. suggested that students will get involved into different assignments if they regard them as valuable and meaningful (Tuan, Chin & Shieh, 2005). Connecting the motivation theories to Mintzes et al. theory (1998) as well as Tuan, Chin & Shieh's (2005) we could consider that motivation behind student's involvement into R&D-related activities resides in the relationship built between motivation and the aforementioned independent variables.

Learning values could be explained as students' ingenuity into giving certain values to activities they engage in (Tuan, Chin & Shieh, 2005) like problem solving or science inquiry (American Association for the Advancement of Science 1993, NRC 1996). Therefore, our first hypothesis is: there is a significant, positive and strong relationship between learning values and motivation towards getting actively involved into R&D-related activities. Other researchers have concluded that there might be an essential link between attitude and success towards learning courses (Gilbert, 2001), there, by extension, there might also be a liaison between attitude and motivation towards R&D activities, as a person's predisposition to react in a certain manner to external factors as situations, concepts etc. (Singh, Misra & Srivastava, 2017). Our second hypothesis illustrates that there is a significant, positive and strong relationship between attitude and motivation towards getting actively involved intro R&D-related activities. Learning environment comprises student to student relations and information exchange, the teacher's pedagogy techniques and engagement with students (Fencl & Scheel, 2005), an environment with significant influence over students' confidence (Newstreet, 2008). Hypothesis three: there is a significant, positive and strong relationship between learning environment and motivation towards getting actively involved into R&D-related activities. Self-efficacy represents a student's knowledge of his/her capabilities to reach a specific goal (Bandura, 1997). Hypothesis four: there is a significant, positive and strong relationship between self-efficacy and motivation towards getting actively involved into R&D-related activities. Even though the initial SMTSL questionnaire treated achievement goals and performance goals as two separate variables, this study will use achievement goals as a final, fifth variable which is defined by students endeavors to execute and complete their goals or tasks. (Midgley, Kaplan & Middleton, 2001). Hypothesis five: there is a significant, positive and strong

relationship between achievement goals and motivation towards getting actively involved into R&D-related activities.

Methodology

As mentioned before, the main goal of the study was to adapt, with consistent alterations, the original SMTSL questionnaire (Tuan et al.2005a) and Singh, Misra and Srivastava's (2017) survey, into Romanian language and to evaluate an academically and ethnically distinctive group with a slightly distinctive goal: its' knowledge and involvement into academically R&D-related activities. Moreover, the adaptation of the SMTSL was tested in a completely different age group other than undergraduate participants, that is, students of Bucharest's universities aged over 18 years old. We were interested into investigating the structure of the new adapted survey in a group of composed of different general (bachelor) and specialized (master's degree) majors.

- *The instrument*

The requirement to develop a reliable and accurate mechanism to assess students' motivation to get involved into R&D-related activities during the course of their studies was indisputable in the context of a non-innovative country with a massive lack of knowledge-oriented specialists. Documenting Romanian students' motivation into participating in R&D-related activities could allow us to develop both educational and motivational strategies in order to enhance future employee's active involvement into specialized research activities.

Previous studies used the SMTSL questionnaire in different cultural contexts and subjects (e.g. Dermitzaki et al., 2012; Singh, Misra and Srivastava, 2017) resulting in the same six or less factors and associations using both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The following study used EFA in order to confirm if the six factors mentioned in SMTSL were applying to our specific situation.

Our new conceptual framework of the survey with 45 items was structured into two units. The first unit is a representation of Lopatto's (2004) SURE Survey and contains respondents' background information as well as questions regarding R&D-related activities, career and the importance of gaining experience by having a job throughout university years or getting specialized knowledge by getting involved into research. The second unit contains items measuring motivation, achievement goals, learning values, learning environment, self-efficacy and attitude (Tuan, Chin & Shieh, 2005). Respondents were asked to express their thoughts regarding the aforementioned items on a 5-tier Likert scale where 1 meant strongly disagree 5-strongly agree.

With respect to motivation, as a dependable variable, as Singh, Misra & Srivastava (2017) suggested, we gathered 6 verified statements from the Intrinsic Motivation Inventory (IMI) which we considered suitable for our study. Similar to the independent variables used before, all the statements were measured on a five-point Likert scale, targeting subjects such as: perceived choice, value, perceived competence, relatedness, enjoyment and effort.

The favored method of data collection was the aforementioned questionnaire by the means of an online survey, the data being gathered between February 4th and April 2nd, 2019. The first part of the results was used to understand the process of perceiving the importance of having a job or getting involved into R&D-related activities during university studies. The second part was used to investigate the relationship between motivation and the factors resulted after performing EFA.

- *Respondents*

The researched collectivity was consisting of Romanian students who were undergoing bachelor and master's degree programs at the following public universities of Bucharest: The Bucharest University of Economic Studies, University of Bucharest, Ion Mincu University of Architecture and Urbanism and Polytechnic University of Bucharest. The

questionnaire was distributed to a total of 645 participants with a response rate of 47% (303 participants).
The structure of the inspected sample included 68% female and 32% male respondents, 38% were students of The Bucharest University of Economic Studies, 26.4% of Polytechnic University, 20.5% of University of Bucharest and 15.2% of Ion Mincu University. One hundred and thirty-two respondents were third year bachelor students (43.6%), 17.2% were second-year bachelor students, 15.5% first-year master students, 10.9% second-year master students, 6.9% first-year bachelor students and only 5.9% were fourth-year bachelor students. In order to process and analyze the collected information, IBM SPSS Statistics 20 software was used.

Results and discussion

- *General perceptions about career and R&D-related activities*

The introductory unit of our survey collected information regarding students' general perception about getting a full time job or orienting their energy and resources into acknowledging R&D-related activities by participation to conferences, specialized researches, summer R&D-oriented schools and other activities that will concur to the professional training of them as future knowledge-oriented employees.
Respondents were asked which activity they considered of great importance in relation to their future professional career and 45.9% considered having a part/ full time job during academic studies being the best option, while 37.3% of them considered the participation to R&D-related activities the most reliable alternative. Even so, 16.8% of the respondents did not take into consideration either of the two options.
When asked about their past participation to R&D-related activities 56.1% of them stated having no experience, while 22.1% had a one semester experience, 12.9% had a multiple semester experience, 3.6% had both semesters and a summer schools experience, 3% had both a semester and a summer school experience and only 2.3% had a summer school experience. Regarding their immediate plans after graduation, most of our respondents (56.1%) declared their intention to graduate the same or a related major master's degree while 13.9% are intending to study a different major. Moreover, 10.2% plan to work in a non-science career without further studies, 8.6% are intending to work and later on continue their studies for a master's or a PhD degree and only 8.3% were intending to get a PhD degree on a similar or even a different major.

- *Exploratory factor analysis*

Regarding the main topic of our analysis, mainly the existence of a significant and positive relationship between each of the 5 independent factors (achievement goals, attitude, learning values, learning environment and self-efficacy) and motivation as a dependable variable, we performed an exploratory factor analysis (EFA) followed by a multiple linear regression.
Regarding the instrument's factorial structure, we performed EFA using principal component analysis with the varimax rotation. As the model was verified before, our analysis was based upon the assumption that all items will be reduced to 6 factors, having Eigen values greater than 1, which showed to be valid. We performed the KMO test in order to establish the adequacy of the sampling, indicating a consistent value of .913 and a significant Barlett's test of Sphericity with *p*-value of .000< .05. All six factors explained a total 59.066% of variance, while factor 5 and 6 explained 2.896% and 2.162% of variance. The rotated component matrix was used, with a cut off point for factor loading of .4.

- *Reliability analysis*

Later on, we performed a reliability test in order to diagnose the internal consistency among each factor's specific items. Applying the criterions proposed by Nunnally (1978), we were interested to discover if Cronbach's α values ranged between the acceptable internal

consistency ($0.7 \leq \alpha \leq 0.9$) and realised that only four out of the six factors could be considered adequate, the last two factors having a poor and unacceptable internal cosistency. Even if some questions were deleted, the internal consitency was not considerably changing. Hence, we decided to perform another EFA, this time with a set of five factors to extract which explained a total 56.114% of variance. Reliability was again carried out, this time Cronbach's α values ranged from .653 to .869, the fifth factor being the only one with a value less than .7. Sharing the prior opinions of similar studies (Cohen, Manion & Morrison, 2000), we considered the internal consistency of the fifth factor loading acceptable. The new number of items (questions) from the second part of our survey, according to EFA and reliability was reduced from 37 to 26, composing a total of 5 principal factors: learning values, attitude, learning environment, self-efficacy and achievement goals.

In order to find out if our five factors have a significant and positive effect towards student's motivation of getting involved into R&D-related activities we performed a multiple linear regression test using standard regression method. Taken as a set, the aforementioned 5 factors account for 70.1% (R^2= .701) in the variance of students' motivation towards getting actively involved into R&D-related activities. According to ANOVA, the overall regression model proved to be statistically significant F (5,297) = 139.233, p<.001, R^2= .701, all five factors influence motivation towards the analyzed activities significantly. Regarding the correlation level between motivation and the five independent variables, according to Table no. 1 we determined that motivation is significant correlated with all the variables p<.05, learning values, self-efficacy, learning environment and achievement goals having p <.001 while attitude had a p<.029. Furthermore, in order to confirm the hypothesis, we need to determine if all of the independent variables are highly important in explaining the variance of our output variable.

Table no. 1. Coefficients

Model	Standardized Coefficients	t	Sig.	Collinearity Statistics	
	Beta (β)			Tolerance	VIF
(Constant)		.094	.925		
Learning Values	.512	12.728	.000	.621	1.609
Attitude	.108	2.996	.003	.772	1.295
Learning Environment	.123	3.408	.001	.771	1.296
Self-efficacy	.232	6.185	.000	.717	1.395
Achievement goals	.307	8.880	.000	.841	1.190

Note: Dependent Variable: Motivation

Source: Authors' own research

Table no.1 showed that learning values proved to exert a significant and strong influence on the motivation towards getting involved into R&D-related activities (p=.000 and β=.512), hence proving the first hypothesis. The relationship between the independent variable attitude and motivation was also found to be significant and positive, but weaker than the prior mentioned (p=.003 and β=.108), proving partially the second hypothesis. The same situation can be found with the third factor of our model, learning environment, which exerts a significant, positive and slightly high influence over motivation towards getting involved into R&D-related activities (p=.001 and β=.123) confirming the third hypothesis. Our last two independent variables, self-efficacy and achievement goals are significantly,

positively and highly influencing motivation having p=.000, β=.232 and p=.000, β=.307, therefore confirming the last two hypotheses.

Conclusions

According to the European Innovation Scoreboard (2018), Romania has been the EU most modest innovator, having firm investments and general innovations as the weakest innovation dimensions, with human resources involvement into R&D activities below the EU's average (EIS, 2018). Taking into consideration this disquieting situation, we were interested to apply and develop a reliable tool in order to investigate the main factors that lie behind students' motivation towards getting involved into R&D-related activities and into becoming knowledge-oriented professionals.

Our analysis started as an application of Tuan's et al. (2005a) SMTSL questionnaire in Romanian language, with certain alterations according to our goals, and a further test of content and construct validity of the model by the means of EFA and reliability analysis.

Even though we started from the assumption that all the six independent variables will prove to be internal consistent, only five of them revealed the hypothesis having consistent values of factor loadings. Therefore, in order to improve the new model (with alterations) we based our study on five hypotheses which later on, proved to be valid. However, after processing the results, in order to increase the internal consistency of the five scales, some questions were eliminated in order to improve the alpha coefficient. After performing multiple linear regression, our findings suggested that students' motivation towards getting involved into R&D-related activities is positively influenced by the following variables: learning environment, learning values, self-efficacy, achievement goals and attitude.

The first variable, learning values, displayed a strong, positive and significant correlation with motivation towards getting actively involved into R&D-related activities, detailing the fact that learning R&D, applying the information in both professional and daily life, cultivating new skills and becoming capable of solving different problems represent highly motivating variables for the future professionals. The second hypothesis regarding attitude's level of significance and importance towards motivation, reflected a significant, positive but weaker influence than all the other four variables. In this case, attitude portrayed the individual's intent regarding his/her ability to cope, understand and apply R&D-related information or techniques, and the willingness to make efforts when needed. Hence, in this case, attitude reflected a reduced impact than predicted. The learning environment, which in our case was defined by the built relationships between fellow students, with teachers and even with the university, reflected a significant and positive association with motivation. Hence, student's group membership, the relationships built inside that group and mostly information exchange, will motivate him/her to become more involved into R&D-related activities. Also, professor's attitude regarding facilitating and helping a student on the research process will also reflect onto student's motivation (Beswick, 2006). Self-efficacy, as a variable which illustrates the inner confidence of a young researcher to perform well and be comfortable with R&D-related subjects and activities, was significant and highly correlated to motivation, which means that a future professional is willing to get involved into R&D-related activities if he/she is certain about the knowledge he/she possesses. The last independent variable of the study, achievement goals, illustrated in our scenario, details the goals a student engaged in R&D-related activities is pursuing, like university appreciation, better grades or even competition prizes. Moreover, if student's efforts are being formally recognized by the university, he will be actively involved and will considerably increase his willingness into getting more involved in such activities. Therefore, the fifth hypothesis is confirmed by a significant, positive and strong effect over motivation towards participating into R&D-related activities.

With regard to the existing internal correlations between the five variables, we observed

high correlations between learning values with achievement goals and self-efficacy, which could make sense if we are considering that a student's goal regarding R&D involvement could only be achieved by having a concrete outlined perspective and knowledge about itself capabilities.

As far as students' general perceptions about career and R&D-related activities go, almost half of the respondents considered that acknowledging R&D information from activities performed at university will not contribute to their professional training for jobs or other professions of the future, most of them feeling that the information they are getting is, unfortunately, not up to date. Moreover, when asked about their participation to R&D-related activities, 170 of the respondents did not have experience at all and were not interested to find more about participation to a research, a conference or even a small study group. This result showed that, even though they had different academic background, their overall attitude and perception was quite similar. In the end, according to EIS (2018), since 2007 the number of Romanian students interested in doctoral studies has decreased by 50%, a worrying situation being illustrated by our respondents whom showed only a 3% interest in becoming skilled professionals by the means of the aforementioned studies.

To conclude, this study could be considered as an adjuvant for prior SMSTL-related studies, illustrating that motivation towards getting involved into R&D-related activities is influenced by specific variables, but also, the small found discrepancies may reveal that different cultures, ages and even academic background could interfere with the model's structure (Pintrich, 2003). Future researches could explore student's motivation towards getting involved into R&D in relation to their university affiliation, gender or even academic background. Investigating the variables that affect students' motivation in a specific area of expertise might be the resource of effective information to both university teachers and business managers or entrepreneurs, in order to create adequate strategies for increasing the professionals' (students or employees) competencies and stimulation of interest into absorbing new information according to their majors or activity fields. Hence, according to specific strategies, investments into human capital might break all our national innovation barriers and become a mandatory input in the new knowledge economy.

Acknowledgement

This paper was co-financed by The Bucharest University of Economic Studies during the PhD program.

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