The Impact of Knowledge Creation on the Creative Thinking of University Students Developing Project Ideas: A Case Study

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Abstract:

This study aims to highlight the impact of the knowledge creation process, as defined by the SECI(socialization, externalization, combination and internalization) model, on creative thinking among students exploring project ideas at a university in western Algeria. The study was conducted among 50 students during the 2024-2025 academic year. A statistically significant positive impact was found for the knowledge creation process on creative thinking, at a rate of 46.6%.

Analysis of the results reveals, on the one hand, the limitations of explicit knowledge acquired in the field of innovation, particularly in view of students' rampant use of artificial knowledge. On the other hand, it highlights the importance of promoting tacit knowledge, which remains underdeveloped among students. In this regard, it is essential to strengthen partnerships between universities and companies with recognised professional experience. Such collaboration would enable students to acquire practical, experience-based knowledge, helping them to effectively apply their theoretical learning and successfully complete their projects.

Keywords: knowledge creation; creative thinking; tacit knowledge; explicit knowledge; artificial knowledge; SECI model.

1. INTRODUCTION

In the context of the knowledge economy, digital transformation in the context of the knowledge economy and digital transformation characterised by artificial intelligence, the role of the university has evolved beyond traditional teaching and knowledge transfer. Today, universities are expected not only to disseminate knowledge but also to create, apply and manage it while fostering an environment that stimulates creativity among students (Karunarathne & Calma, 2024). Within this framework, knowledge management emerges as a strategic lever for competitiveness and excellence (Bandera et al., 2017). It encompasses a set of processes—collecting, integrating, transforming, and creating knowledge—that act as a catalyst for creativity and innovation (Kianto, 2011; Bandera et al., 2017). Knowledge itself can be understood as the integration of information and experience in the right context (Prusak & Davenport, 1998). It takes two main forms: explicit knowledge, which is articulated in formal language, codified in documents, and easily stored, transferred, or shared (Nonaka et al., 2000; Djeflat, 2006) and tacit knowledge, which resides in the minds of individuals and is embedded in technical skills, acquired practices and lived experiences that underpin creativity (Polanyi, 1966; Djeflat, 2006, 2008; Datoussaid, 2018, 2019, 2020). Building on Polanyi's seminal insights, systemic approaches to technical change expanded this distinction at the macroeconomic level (Lundvall, 1996; Foray, 2009; Nelson & Winter, 1982), while at the microeconomic level, Nonaka and Takeuchi (1995) developed the influential SECI model. This model conceptualizes knowledge creation as a spiral process in which tacit and explicit knowledge continuously interact through four stages socialization, externalization, combination and internalization driving creativity characterized by originality, flexibility, fluidity and problem sensitivity (Runco, 2007). It is estimated that between 85% and 90% of organizational knowledge is tacit, "locked in the heads" of individuals (Nonaka & Takeuchi, 1995; Djeflat, 2004). Explicit knowledge, by contrast, represents only a small fraction of a company's overall knowledge assets (Datoussaid & Hamadi, 2016) and is closely tied to scientific knowledge generated largely through R&D (Foray, 2009). In developing countries, where R&D capacities remain limited (Djeflat, 2017),

this imbalance reduces the potential to transform explicit into tacit knowledge, thereby constraining creativity.

Against this backdrop, the present study examines the impact of this imbalance in forms of knowledge among students at a university centre in western Algeria when they develop ideas for start-up projects. Specifically, it investigates the extent to which the SECI model fosters knowledge creation processes that enhance students creative thinking. The guiding research question is therefore: to what extent do knowledge creation processes influence the creative thinking of students exploring start-up project ideas according to the SECI model at a university?

The remainder of this article is structured as follows: the next section reviews the SECI model and the theoretical underpinnings of knowledge creation and creative thinking. This is followed by the development of hypotheses, which are empirically tested on a sample of students engaged in entrepreneurial projects. The final sections present the results, discuss their implications, and conclude with insights for both theory and practice.

2. Literature review

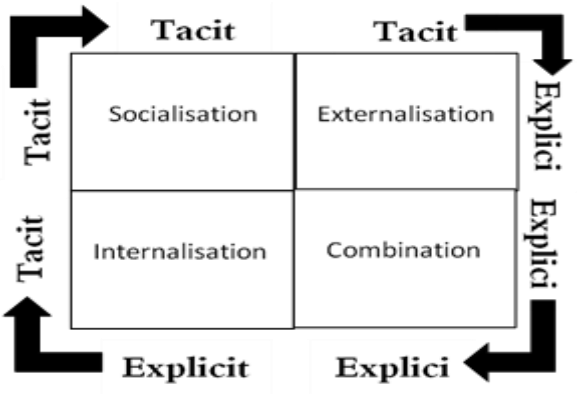
In this part, we will review the theoretical literature related to the knowledge creation according to the SECI model and present the various concepts associated with creative thinking and its skills.

2.1 SECI knowledge creation model

The SECI model of knowledge creation was first proposed in 1991 by Nonaka Ikujiro and was introduced and expanded upon in 1995 in Nonaka Ikujiro and Takeuchi Hirotaka's book_ *The Knowledge- Creating Company* . It has been widely accepted by management practitioners for its distinction between explicit and tacit knowledge (Rice & Rice, 2005, p. 671). It has also become highly influential in knowledge management companies due to its validity in terms of concept and application (Tatiana & Ikhilchik, 2011, p. 56). The model describes the process of knowledge creation at the individual, collective and organizational levels as a whole (Meza et al, 2024, pp. 2-3), kknowledge creation is the interaction between explicit and tacit knowledge in a spiral process that leads to the creation of new knowledge (Nonaka & Konno, 1998, p. 42) and it is the development of new content or the updating

of the organization's existing tacit and explicit knowledge (Alavi & Leidner, 2001, p. 116) and also means the organization's ability to develop new and useful ideas and solutions related to the organization's activities, from products to technological processes to management practices. (Andreeva & Kianto, 2011, p. 1018).

Figure1 : the SECI process



Source: (Nonaka, Toyama, & Konno, 2000)

2.2 The creative thinking skills:

Creative thinking has become increasingly important due to intense competition, uncertainty, and the complexities imposed by the covid-19 pandemic as the latter has made individuals more resilient to change. It is defined as a tangible skill, based on knowledge and practice, that helps individuals achieve the best results in an environment characterized by constraints and challenges (Karunarathne & Calma, 2024; Datoussaid et al, 2020; Hamadi et al, 2021; Farhane et al, 2023). It is also defined as an individual's mental activity that leads to the generation of innovative ideas and solutions characterized by flexibility, fluidity, originality, and a high capacity to be sensitive to problems and interact with them in unconventional ways (Boukerrit & Chorfi, 2022, p. 181).

Creative thinking skills are based to a certain extent on the work of Guilford (1973). These skills include: fluency, i.e. the ability to produce numerous ideas and solutions to a given problem; flexibility, i.e. the ability to go beyond traditional patterns of thinking by adapting to new or changing situations; originality, which refers to an individual's ability to generate new and rare ideas related to the problem at hand that did not exist before, or to

produce original and non-repetitive responses; and finally, sensitivity to problems, which depends on an individual's ability to perceive problems, see gaps, notice unusual things in their environment, and ask questions about them.

3. Research Model and Hypotheses

According to the SECI model (Figure 2), knowledge is created through four different stages. We compared each of the four stages separately using a new variable, namely creative thinking. We were able to formulate the main hypothesis and four secondary hypotheses to support our study:

Main hypothesis: The creation of knowledge has a positive impact on students' creative thinking who explore start-up project ideas at the university.

First sub-hypothesis: The Socialization (from tacit knowledge to tacit knowledge): where tacit knowledge is transformed by the interaction between individuals, observation, imitation and practice (Nonaka, 1994; Datoussaid, 2019), or spending time together and living in the same environment. (Nonaka et al, 2000, p. 09), (Handzik & Chaimungkalanont, 2004) proved in their study that there is a strong relationship between socialization and creative thinking, which leads us to formulate the first sub-hypothesis:

H1: The socialization process has a positive impact on students' creative thinking with projects at the University Center.

Second sub-hypothesis: The externalization (from tacit knowledge to explicit knowledge): tacit knowledge is expressed and translated into comprehensible forms so that the individual transcends the internal and external boundaries of the self (Nonaka & Konno, 1998, p. 43), When implicit knowledge turns into explicit knowledge that can be shared among individuals and becomes a basis for creating new knowledge, and that the success of the process depends on the sequential use of metaphors, comparisons and models that are directly related to creative thinking (Nonaka et al, 2000, p.09), this leads us to formulate the second sub-hypothesis:

H2: The externalization process has a positive impact on students' creative thinking with projects at the university center.

Third sub-hypothesis: The combination (from explicit knowledge to explicit knowledge): explicit knowledge is collected inside and outside of the organization, sorted, processed to create new knowledge and then disseminated among individuals using databases (Nonaka et al, 2000, pp. 9-10), and exchange mechanisms such as the telephone and meetings (Nonaka, 1994, p.19), Alavi and Leidner (2001) confirmed that the synthesis process has a direct relationship with creativity, which leads us to highlight the third sub-hypothesis:

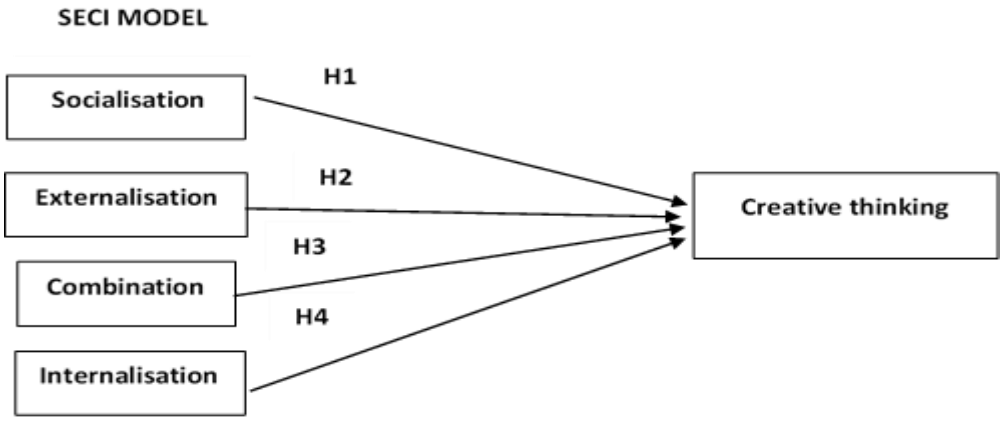
H3: The combination process has a positive impact on students' creative thinking with projects at the University Center.

Fourth sub-hypothesis: The Internalization (from explicit knowledge to implicit knowledge): the individual transforms explicit knowledge into implicit knowledge and by identifying the organizational knowledge he needs, this process is achieved through learning and practice (Nonaka & Konno, 1998, p. 45); (Yeh et al, 2012) emphasized that the process of externalization has a positive impact on creative thinking, which leads us to highlight the fourth sub-hypothesis:

H4: The internalization process has a positive impact on students' creative thinking with projects at Nour Elbachir EL Bayadh University Center.

Creative thinking: it is defined as a problem-solving method and requires a set of skills such as flexibility, originality, fluidity, and sensitivity to problems (Garay & Quintana, 2021, p. 266).

Figure2 : the research model



Source: Authors

4. Methodological procedures:

In the theoretical part, we adopted the descriptive approach, which identifies the various concepts related to the study variables based on multiple sources. As for the applied part, we relied on a case study, using the analytical approach to analyze the statistical data.

4.1 research framework:

The field study was conducted at the Nour Al-Bachir University Center in Al-Bayadh during the period from April to June 2025, we selected a random sample of students from the center having developed ideas for start-up or business projects, 50 out of 90 students, and 50 paper questionnaires were distributed which were collected in their entirety.

4.2 Research design of the methodology: data collection

Part 1: contains the respondent's personal information such as gender, education level, institute and project type.

Part 2: contains the study questions, which were constructed on the basis of different studies (Nonaka & Ikujiro, 1994; Nonaka and al, 1998; Andreeva and Ikhilchik, 2011; Guilford, 1973. The questionnaire was composed of 32 questions divided into two axes: the first was devoted to the independent variable (SECI model) with four dimensions (socialization, outsourcing, combination and internalization) with a total of 16 items, whereas the second axis was devoted to an axis for dependent variable creative thinking and included 16 items. The questionnaire results were processed by SPSS using various indicators such as stability coefficient, frequencies and percentages, the arithmetic mean, standard deviation, inflation and variance coefficient, normal distribution test, correlation coefficient and determination coefficient to test hypotheses.

5. Results:

We will analyze the questionnaires collected by calculating the stability coefficient, describing and analyzing the study data and variables, and testing the main hypothesis and sub-hypotheses.

Study stability test: according to table 1, the stability coefficient of the study axes is good, because the stability coefficient for all the sentences of the

questionnaire is 0,87, which is a stability report that can be relied on in the field application of the study.

Table1: stability coefficient value for internal consistency of the study variables

variable	SECI model	Creative thinking	Questionnaire
Cronbach Alpha	0.82	0.76	0.87

Source: Authors

Description and analysis of the study data: according to table n° 2, we note that most of the respondents were women, and their number reached 36, representing 72%, while the number of men reached 14, representing 28%. With regard to the educational stage variable, the number of respondents at master's level reached 37 students, representing 74%, while the number of students at bachelor's level reached 13, representing 26%. With regard to the institute variable, the number of students enrolled in the Institute of Human and Social Sciences reached 17, or 34%. At the Institute of Law and Political Science and the Institute of Technology, they estimated the same number and percentage at 09 students, or 18%, then the Institute of Nature and Life Sciences to 08 students, which is 16%, followed by the Institute of Economic Sciences to 05 students, which is 10%, and finally the Institutes of Letters and Languages and the Institute of Science to one student, which is 02%. Regarding the variable of project type, the number of startup projects reached 27, or 54%, compared to 23 economic business projects, or 46%.

Table 2: Distribution of sample members by gender, educational level, and institute and project type

variables	levels	frequencies	Ratio %
gender	male	14	28
	female	36	72
Level	bachelor	13	26
	master	37	74
institute	Economic science	05	10.0
	Human and social science	17	34.0
	Literature and language	01	2.0
	Law and political science	09	18.0
	Natural and life science	08	16.0
	technology	09	18.0
	science	01	2.0
Project type	startup	27	54
	Economic enterprise	23	46

Source: Authors

5.1 Analysis of knowledge creation outcomes according to the SECI model:

Socialization: according to Table 3, the arithmetic averages for the axis of socialization range from 3.94 to 4.30, with statement 06 ranking first with an arithmetic average of 4.30 and a standard deviation of 0.64, while state 08 was ranked last with an arithmetic average of 3,94 and a standard deviation of 1.20.

Externalization: according to Table 3, the arithmetic averages of the externalization axis range from 3.60 to 4.20, where declaration 09 is ranked first with an arithmetic average of 4.20 and a standard deviation of 0,90, while the statement 12 came in last place with an arithmetic mean of 3.60 and a standard deviation of 1.01.

Combination: according to table 3, the arithmetic means of the axis of combination vary between 4.18 and 4.54, with statement 16 ranking first with an arithmetic mean of 4.54 and a standard deviation of 0.57, while statement 15 was ranked last with an arithmetic mean of 4,18 and a standard deviation of 0.89.

Internalization: According to Table 3, the arithmetic averages of the internalization axis range from 4.48 to 0.67, with statement 19 ranking first with an arithmetic average of 4.48 and a standard deviation of 0,67, while statement 18 was ranked last with an arithmetic mean of 3.72 and a standard deviation of 0.92.

Table 3: Measuring the level of knowledge creation (SECI model) according respondent's perceptions

No	Items	mean	deviation	Admission level	Relative importance
05	The interfaces encourage their students to interact, dialogue, and work together	4.14	0.75	high	3
06	The interfaces organize training courses for their students	4.30	0.64	Very high	1
07	I learn through direct observation and field support from entrepreneurs	4.30	0.81	Very high	2
08	I learn through informal discussions with my colleagues	3.94	1.20	high	4
socialization		4.17		high	

09	I clearly express my entrepreneurial ideas during discussions with others	4.20	0.90	Very high	1
10	I explain my ideas using diagrams and illustrations	4.02	0.99	high	3
11	I write my thoughts, observations and experiences in documents	4.14	0.92	high	2
12	I participate in brainstorming sessions to generate new ideas	3.60	1.01	high	4
externalization		3.99		high	
13	I attend training courses to refresh my knowledge.	4.32	0.89	Very high	3
14	Meetings are an opportunity to exchange knowledge.	4.38	0.75	Very high	2
15	I use chat and email applications to exchange and acquire knowledge.	4.18	0.89	high	4
16	I use electronic documents and references to broaden my knowledge in order to develop my project.	4.54	0.57	Very high	1
combination		4.35		Very high	
17	I benefit from my colleagues' experiences and transform them into new knowledge.	4.30	0.76	Very high	3
18	I attend informal meetings and open meetings to gain knowledge.	3.72	0.92	high	4
19	I am interested in self-learning and continuing education in order to deepen my knowledge.	4.48	0.67	Very high	1
20	I develop my entrepreneurial skills through experience and practice.	4.38	0.63	Very high	2
internalization		4.22		Very high	
Knowledge creation(SECI model)		4.18		high	

Source: Authors.

5.2 Analysis of creative thinking outcomes: according to Table 4, the arithmetic averages for the axis of creative thinking range from 3.56 to 4.22, where statement 23 is ranked first with an arithmetic average of 4.22 and a standard deviation of 0,67, while the statement 24 came in last place with an arithmetic mean of 3.56 and a standard deviation of 0.88.

Table 4: Measuring the level of creative thinking according respondent's perceptions

No	Items	mean	deviation	Admission level	Relative importance
21	I can quickly think of various circumstances	3.84	0.93	high	13
22	I can offer several ideas when faced with a problem.	4.14	0.67	high	04
23	I can think of many solutions to the difficulties I am facing.	4.22	0.67	Very high	01
24	I can produce as many coherent words as possible to express an idea.	3.56	0.88	high	16

25	I can change my way of thinking if the situation changes.	4.08	0.77	high	07
26	I can adapt to new situations.	4.10	0.78	high	06
27	I adapt and learn from my colleagues' perspectives.	4.12	0.77	high	05
28	I can change my position when I am convinced that it is incorrect.	3.98	0.86	high	10
29	I can generate unconventional ideas.	4.04	0.85	high	09
30	I can present previous ideas in a unique way.	3.94	0.89	high	11
31	I can find new uses for existing ideas.	3.82	0.82	high	14
32	I perform my tasks differently from my colleagues.	4.18	0.82	high	03
33	I can notice details that my colleagues don't notice.	4.08	0.80	high	08
34	I can identify the problems facing my project.	4.20	0.69	Very high	02
35	I can gather information about a problem in a short amount of time.	3.70	0.97	high	15
36	I can find creative solutions to the problems my project faces.	3.90	0.86	high	12
Creative thinking		3.99		high	

Source: Authors

5.3 Testing the skewness coefficient, variance inflation factor, and variance covariance

Testing the normal distribution of study variables: based on Table 5, the value of the torsion coefficient was within the range (2.2-), and therefore there is no real problem related to the normal distribution of study variables.

Inflation coefficient and acceptable variance test: based on Table 5, all VIF coefficients were less than 3 and the tolerance value was greater than 0.1. This means that there is no high correlation between the independent variables.

Table 5: Testing the skewness coefficient, variance inflation factor, and variance covariance

variants	Skewness	Vif	tolerance
Socialisation	-0.096	1.50	0.66
externalization	-0.255	1.93	0.51
combination	-0.435	2.61	0.38
internalization	-0.583	1.96	0.51
Creative thinking	-0.113		

Source: Authors.

5.4 Model relevance test: Table 6 shows that the F value reached 9.83, which is statistically significant (Sig=0.000), lower than the significance level α=0.05. This means that the multiple linear regression model proved to be correct, and we therefore validate the main hypothesis.

5.5 Testing the main hypothesis: according to Table 6, the value of the coefficient of determination R^2 was 0.466, which means that 46.6% of the change in the dependent variable (creative thinking) is explained by the change in the independent variable (knowledge creation according to the SECI model), and the rest of the change is due to other factors. Consequently, we confirm yhe validity of the main hypothesis, which states that knowledge creation according to the SECI model has a positive impact on the creative thinking of students conducting projects at the Nour El Bachir Al Bayadh university center.

Table 6: Analysis of ANOVA and analysis of multiple linear regression between the combined dimensions of the independent variable and the dependent variable

source of variation	Degree of freedom	Sum of square	Mean of sqaure	F	Sig	R	R^2
Regression	4	3.35	0.83	9.83	0.000	0.683	0.466
residual	45	3.83	0.85				
total	49	7.19					

Source: Authors

5.6 Sub-hypothesis test:

Testing the first sub-hypothesis: according to Table 7, the calculated t-value was 0.973 and the significance level t sig=0.336, is higher than the approved significance level (0.05), a fact that require the rejection of the alternative hypothesis that is the socialization process has a positive impact on the creative thinking of students with projects at the Nour Elbachir El Bayadh University Center.

Testing the second sub-hypothesis: according to Table 7, the calculated t-value was 0.538 and the significance level t sig=0.593, which is higher than the approved significance level (0.05), which requires rejecting the alternative hypothesis that the outsourcing process has a positive effect on the creative thinking of students with projects at the Nour Elbachir El Bayadh University Center.

Testing the third sub-hypothesis: according to Table 7, the calculated t-value was 2.072 and the significance level t sig=0.044. It is lower than the approved significance level (0.05), which requires accepting the alternative hypothesis that the combining process has a positive effect on the creative

thinking of students with projects at the Nour Elbachir El Bayadh University Center.

Testing the fourth sub-hypothesis: according to Table 7, the calculated t-value was 1.468 and the significance level t sig=0.149. It is higher than the approved significance level (0.05), which requires rejecting the alternative hypothesis that the internalization process has a positive effect on the creative thinking of students with projects at the Nour Elbachir El Bayadh university center.

Table 7: Multiple regression analysis of the effect of the dimensions of independent variables on the dependent variable

Contrast source	B	Standard error	Beta	The calculated T value	T significance level
constant	1.508	0.411		3.668	0.001
Socialisation	0.098	0.101	0.130	0.973	0.336
externalization	0.050	0.093	0.081	0.538	0.593
combination	0.272	0.131	0.365	2.072	0.044
internalization	0.164	0.111	0.224	1.468	0.149

Source: Authors

6. Discussion:

The case study conducted among students who developed projects ideas (bachelor's and master's degrees) at Nour Elbachir University Centre in El Bayadh during the 2024-2025 academic year revealed significant results concerning the link between knowledge creation, and creative thinking according to Nonaka and Takeuchi's SECI model (1995). The results indicate that knowledge creation has a positive impact on students' creative thinking, but this impact was mainly evident in the combination phase, i.e. the transformation of explicit knowledge into new explicit knowledge. In other words, students mainly drew on the theoretical knowledge acquired during their studies, often from the modules taught, which limited their ability to generate truly innovative ideas. This predominance of the ‘combination’ dimension can be explained by students' dependence on explicit knowledge, which, according to Nonaka and Takeuchi, represents only about 20% of overall knowledge. Conversely, the use of tacit knowledge – essential for creativity and innovation – proved to be virtually non-existent. This can be explained by the lack of concrete experience in the professional environment,

where tacit knowledge generally develops, particularly through learning by doing, professional routines, and field experience (Datoussaid, 2019). As an academic institution, universities do not yet sufficiently integrate this type of knowledge, creating an imbalance between the knowledge available to students and that which can actually be used to bring innovative projects to fruition. Thus, the inability of some students to carry out their projects is not solely due to limited creative skills, but above all to a lack of tacit knowledge and a weak ability to transform explicit knowledge into concrete actions. This problem is exacerbated also by the weak links between universities and industry (Andersson & Djeflat, 2013; Datoussaid et al, 2024), which limits access to real-world learning situations that are essential for the development of operational skills.

Focusing the socialisation process, its level was high according to Table 3, but it had no effect on creative thinking. This can be explained by the students' inability to effectively convert or share their tacit knowledge with each other . In other words, even though exchanges took place, they were unable to transmit or assimilate implicit knowledge useful for creativity. This may be due to a lack of common context, shared language or practical experience.(Handzik and Chaimungkalanont;2004) confirm that the transformation of tacit knowledge into other tacit knowledge (e.g. through social learning or shared experience) is crucial for stimulating creativity and creative thinking. Furthermore, according to Bandera et al. (2017), the process of coaching or mentoring, often in an entrepreneurial context, promotes the creation of a shared culture in start-ups, which is essential for tacit knowledge to circulate effectively.

Concerning the *externalization process*, its level was high according to Table 3, but it did not positively affect creative thinking due to limited explicit knowledge (20% or less), which hinders the expression of creative ideas. In this context Azzam, He, & Sarpong, (2020) confirmed that the process of transforming implicit knowledge into explicit knowledge stimulates creative thinking and strengthens the organizational memory of the organization (Farnese et al, 2019).

Regarding on the *combination process*, its level was high according to Table 3, which positively affected creative thinking by 46.6%. This process

depends on available explicit knowledge, which is consistent with the study (Mitchell & Boyle, 2010), which confirmed that the transformation of knowledge from explicit to explicit positively affects the creative capabilities of the organization, and the study (Yeh et al, 2012), which confirmed that the synthesis process improves students' creativity. The rest of the impact is due to other factors such as motivation, environmental factors, and leadership (Vuichard et al, 2023).

With regard to the *internalization process*, its level was very high according to Table 3, but it did not positively affect students' creative thinking, due to the difficulty of converting explicit knowledge into tacit knowledge, as according to (Yeh et al, 2012). In this case, Hu et al, (2023) confirmed that the process of transforming knowledge from explicit to implicit positively affects creativity.

7. Conclusion:

The findings of this study indicate that the success of student projects cannot be attributed solely to individual creativity. Rather, they highlight the importance of examining the extent to which explicit knowledge acquired in an academic setting effectively contributes to the generation of relevant and innovative project ideas, particularly in a context marked by the rampant use of artificial knowledge. Furthermore, these results open up two avenues for reflection: on the one hand, the need to explore the existence and nature of the links between innovation and artificial knowledge; on the other hand, a more in-depth reflection on the status of tacit knowledge: does this knowledge really exist among students at this stage of their development, or does it still need to be deliberately cultivated through experiential learning and practice. Given that tacit knowledge accounts for nearly 80% of an individual's overall knowledge base, its limited development could be a major obstacle to transforming knowledge into creative and exploitable results.

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