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RESEARCH ARTICLE

Cognitive Engagement and Motivation in Education: A Psychological Perspective

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ABSTRACT

The objective of the current research is to analyze the effect of psychological need satisfaction on intrinsic motivation and cognitive engagement in terms of higher education and through the theoretical idea of Self-Determination Theory (SDT). The study will seek to address a gap in knowledge that is a critical one as far as the determination of how the perceptions of students towards autonomy, competence, and relatedness can not only lead to their motivation but also that of cognitive investment with regard to learning to which they invest. The research will be conducted in mixed format, with quantitative data analysis method of the structured surveys completed by 200 university students, and quantitative data analysis of 30 semi-structured interviews (so that no more than one hour is spent on each interview). It is thanks to this two-fold strategy that both measurable trends and lived lives can be approached as a whole. The results indicate mediating impact of the intrinsic motivation between the fulfillment of the psychological needs, and cognitive engagement, and therefore the significance of internalized drive in development of meaningful learning behaviors. The best indicator of engagement was competence, as compared to other two psychological needs that imply that students who perceive themselves as capable and skilled will be more likely to put more cognitive efforts in their study work. In addition to that, the findings indicate the importance of the autonomy-supportive environment and the favorable relations with the peers and instructors which, when united, contribute to the promotion of the motivation and persistence of the students in the academic life. Theoretically, the current study is an extension of SDT since it proposes the elements of Expectancy-Value theory and the Achievement Goal Theory since it offers a more holistic motivational concept. It also takes to account cultural dimension which identifies the perception of autonomy and relatedness of students therefore providing a more comprehensive and context sensitive interpretation of the motivational mystery in learning institutions.

Keywords: Self-Determination Theory; intrinsic motivation; cognitive engagement; psychological needs; education

1. Introduction

One of the subjects of interest that have been used in researching the educational psychology is the interaction between cognitive engagement and motivation. In a learning situation it is the intellectual activity and involvement in the learning processes by the students and this is not necessarily being in a classroom [1].

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It involves the students to get absorbed in the material, think, problem solve and put into practice. It is well known that cognitive engagement is a strong predictor of academic success since it dictates the extent to which students dedicate efforts to cognition and memorisation of information [2]. Cognitive engagement of students during learning increases their chances of learning intricate concepts and retaining them in the long term resulting in improved students academic performance. It is thus important to understand how things determine cognitive engagement especially motivation so as to enhance the quality of education [3].

One of the driving forces behind how far students are willing to apply their mental effort to the learning process is motivation. It motivates the students to initiate, persist as well as participate in learning. These forms of motivation may be either intrinsic or extrinsic motivation, in the former case, students are motivated by intrinsic values in the form of intrinsic satisfaction and interest in learning, in the latter case, students are motivated by extrinsic values in the form of extrinsic rewards or pressures in the form or grades, teacher approval, or career advancements. Intrinsic and extrinsic motivation both have a role in how students go about their learning, though the nature of motivation may have different impacts based on whether it is intrinsic or extrinsic and the degree and even sustainability of engagement [4].

This makes motivation a highly significant determinant of success in the education since it determines how the students approach their learning processes and how they will be involved in the learning process. At school, there are many external and internal factors that may influence the students in relation to their motivation. The personality factor, the past experience of students with learning, their interests and goals can be the internal factors [5]. The examples of extrinsic variables are classroom setting, teaching method, teacher contribution, social and emotional climate in schools or colleges. The correlations between them and how they affect the motivation and exploring are the core of designing instructional environments that will help to achieve maximum student learning and success [6]. The motivation issue also has elicited much research on the subject of educational psychology and numerous theories and models have been put forward in the effort to learn the role of motivation in education.

Self-Determination Theory (SDT) is one of the numerous theories of motivation whose impact has appeared to be the most significant in the study of the connection between motivation and learning [7]. According to SDT, there are two forms of motivation, that is intrinsic motivation and extrinsic motivation. Intrinsic motivation is instigated internally in the person such that the process involved in the activity is intrinsically pleasant or gratifying. On the contrary, extrinsic motivation comes in due to external stimulus to do something, like reward, grades or social approval [8].

Self-Determination Theory reveals that the main secret of promoting intrinsic motivation is by satisfying three fundamental psychological requirements of autonomy, competence, and relatedness. Autonomy is the requirement to have a feeling of power over what one does and chooses, to have a feeling of freedom and choice [9].

Competence implies that one must feel competent in what they are doing, learning mastery and development [10]. Relatedness refers to the fact that there is the need to feel related to other humans, the need to experience support and significant relations [11]. According to SDT, the satisfaction of these psychological needs leads to an increased possibility of individuals becoming more intrinsically motivated therefore leading to increased cognitive engagement and learning efficiency. To the contrary, lack of these needs can result in compromised motivation, which can de-motivate or make the students ineffective in their learning activities [12].

The study is expected to discuss the ways in which the satisfaction of the basic psychological needs identified in SDT could predetermine the motivation of the students and their ability to think cognitively

regarding the learning material. The proposed study is expected to provide new information about the impact of motivation on the extent of engagement of the students in the learning activities and their performance in schools when using the SDT in the educational context. To be specific, the paper will dwell down on how the need fulfillment of autonomy, competence and relatedness may lead to rise in the intrinsic motivation which will in turn lead to rise in cognitive engagement and performance of the academic work.

The results of this study may have some useful information to be known to guide the education practice. As an illustration, classroom settings that promote autonomy, competence, and relatedness will be created by teachers who understand that these concepts are important in the process of encouraging motivation, which consequently creates more intellectual stimulation and better learning experiences. Besides, this study could assist teachers to be aware of the weaknesses of extrinsic motivational tools and how excessive dependence on grades or some other external stimuli may hinder extrinsic motivation and diminish the overall engagement of students.

The significance of motivation and mental involvement in the education process cannot be overestimated. Engaged and motivated students are more pre-disposed to performing in an academic environment, to grasp a better idea of the material and to have a pleasurable experience of the learning process. Motivated and engaged students tend to acquire lifelong learning skills in the long run and this is crucial to their success in academic and professional life. Moreover, intrinsic motivation and cognition are connected to self-regulation, which is the capability to plan, track, and modify one of the learning approach. The students with high self-regulation are more likely to be successful in the further education and further, as they will be able to take charge of their learning and may continue to learn despite the difficulties.

In this study, some of the most important questions related to motivation and cognitive engagement in the field of education are addressed: How do intrinsic and extrinsic motivation differ in their effects on cognitive engagement? What is the contribution of autonomy towards deep engagement in learning? What can teachers do to achieve learning environments that meet the requirements of students concerning competence and relatedness, and thus, promote motivation and engagement? By answering these questions, the study shall add to the literature that has been gaining momentum in motivation and cognitive involvement in learning institutions.

The effect of intrinsic motivation on cognitive engagement will be discussed as a central concept. Students who are intrinsically motivated are motivated by the subject matter or love of it and not by rewards. They will tend to be more involved in the content, evaluate information more critically, and keep going despite the obstacles. Such motivation is associated with increased academic performance because intrinsically motivated students would take more initiative in their study and strive to master the content.

Conversely, extrinsic motivation, as effective in certain circumstances, may lead to surface work and focus on extrinsic reward, e.g. grades or even approval, rather than perceiving the subject of study as interesting. Besides, cognitive engagement is not connected only with the role played by the students in the learning process, but also related to the quality of this role. Engaging students will be inclined to apply more profound skills of learning such as self-regulation, critical thinking, and problem-solving. The plans are significant in the education of complex ideas and abilities that are required not just at the school level but also in real life. The more student participation the more the likelihood of students retaining the knowledge to be gained that they will be able to put the knowledge to practical use upon completion of long term outcomes of learning.

With the focus on interaction of motivation and cognitive engagement, the provided study will provide invaluable information regarding how the teachers can make the learning process as productive as possible.

The educators can increase the level of intrinsic motivation and motivate more people to engage in the learning process through the creation of an atmosphere that promotes autonomy, competence, and relatedness. It can also lead to better performance in school, greater enjoyment in learning, learning of life time skills that will be useful to the students even when they are not in school.

It should be known how motivation and cognitive engagement can be associated to improve the educational results. The Self-Determination Theory (SDT) that is implemented in the educational context is a wonderful example of studying how intrinsic motivation and satisfaction of psychological needs can be used to enhance cognitive engagement and academic performance. The dynamics will be addressed further in the paper and suggestions made on how the educators can make the learning environments more interesting and motivating.

1.1. Overview of cognitive engagement

Cognitive engagement is the mental investments and active involvement that the learners make in the learning activities. It is also considered to be a process in which students engage and manipulate information, solve problems, and contribute to the process of learning. The cognitive engagement is not just mere attendance or merely attending a course, but rather critical thinking, self-regulation and persistence to go through the obstacles, to get deep, fully engaged with the content. It is admitted to be one of the main predictors of academic success because engaged students are better able to absorb the information and memorize it than their less engaged counterparts [13].

Studies have demonstrated that cognitive involvement is both necessary in the short term academic performance as well as in the long term learning performance. In one study by Fredricks, Blumenfeld and Paris (2004) it was observed that, when students were engaged cognitively, their achievement and comprehension of the subject matter were high. Cognitively engaged students take risks and continue to work despite the challenges, resulting in their skills to solve problems and enhance their performance [14].

Learning participation is an active process that may depend on various factors, such as the individual traits of students, learning environments, as well as, teaching strategies. Academic motivation is mainly a cognitive experience and that intrinsic and extrinsic factors among others influence it [15]. This interaction of students with materials stands not only to the interests of the students themselves but also to the character of tasks and the conditions under which the students are put.

1.2. Motivation in education

Motivation is critical towards promoting thinking in the learning process. It means motivations or purposes of student behaviors and the effort that they devote to studying. Two major forms of motivation namely intrinsic and extrinsic. Intrinsic motivation occurs when students get involved in tasks because they find pleasure in it or they feel satisfied with the work or they are interested in the work. Extrinsic motivation on the other hand is motivated by external factors i.e. grades or praise [16].

The intrinsic motivation is essential especially in regard to cognitive engagement since it promotes a higher degree of involvement and perseverance. Intrinsically motivated students are more interested in the learning process and will be more energetic, creative, and critical thinkers. Furthermore, the intrinsic motivation results into long-lasting interest in the topic under consideration and development of a growth attitude and willingness to learn new subjects [17].

Although extrinsic motivation is effective in the short run, it might not result in long-term cognitive engagements. Extrinsic rewards devalue intrinsic motivation provided that they are not properly handled like grades. When the students are motivated by extrinsic factors only they might not be interested in the content

but the rewards. This lack of intrinsic motivation may restrict the cognitive process and cause a decrease in the learning effectiveness in general [18].

1.3. Self-Determination Theory (SDT)

One of the most well-known theories of motivation in educational psychology is Self-Determination Theory (SDT) that were created by Edward L. Deci and Richard M. Ryan. According to SDT, people are driven by satisfaction of three fundamental psychological needs that include autonomy, competence, and relatedness. SDT states that with these needs satisfied, people will have increased intrinsic motivation resulting in increased engagement and enhanced performance [19].

- **Autonomy**: The autonomy need is the need to have control and choice of what to do. Also, in schools and the educational establishment, intrinsic motivation is more probable among students who feel that they contribute to the learning process, either due to choice of topics, processes or objectives. Students who feel that their learning environment supports their autonomy are more motivated and interested in the process of learning [20].
- **Competence**: The competence need implies the ability to sense the effectiveness and competence of the actions. Students will be more motivated and engaged when they think that they can perform at tasks and empower their skills. This is usually reinforced in learning settings through the offering of relevant challenges and feedback that can assist the students to develop. According to Ryan and Deci, perceived competence is an influential factor to engage in cognition because it develops confidence, and it promotes perseverance [21].
- **Relatedness**: Likewise, the relational desire is the desire to have significant relations with other people. Learners in a school environment feel encouraged when they sense that the teachers and other students in the school support them to learn. According to Deci and Ryan, students receive high levels of intrinsic motivation and engagement when they believe that relationships they have are positive and that their contributions are being adequately appreciated [22].

In SDT, intrinsic motivation is the most effective motivation that can be applied to promote cognitive engagement since it is self-sustaining. Students who are intrinsically motivated are more invested in the content, become more persistent and have more academic success. When the three psychological needs that are discussed in SDT are fulfilled, more autonomous types of motivation will be achieved, and they are associated with increased cognitive engagement [23].

The internalization of motivation, which leads to the increase of the sense of volition and control (autonomy), efficacy (competence), and belonging (relatedness) in individuals occurs through satisfying the psychological needs according to SDT. This internalization turns outside jobs into self-endorsed objectives thereby increasing intrinsic motivation and promoting further thinking.

1.4. Previous research on motivation and engagement

There is a large amount of literature that agrees with the concept that motivation is a key driver in enhancing cognitive development and academic performance. As an example, it have proven that students who are intrinsically motivated are more willing and eager to undertake learning activities that result in an improved comprehension and retention of information [24]. Equally, it has been established that motivational factors have a strong relationship with cognitive engagement, and motivated students have a high possibility of using deep learning strategies [25]. The students who were supported in their autonomy by means of active learning strategies were more apt to feel intrinsic motivation and think at a higher level [26]. This is in line with what he found out that autonomy-supportive environments increase intrinsic motivation and achieve a

high academic engagement [27]. Nevertheless, the difficulties associated with the balancing between intrinsic and extrinsic motivation in the context of schools have also been mentioned in studies. Excessive dependence on extrinsic rewards, in this case grades, can reduce intrinsic motivation and can also lead to the loss of cognitive involvement. Hence, it is important that intrinsic motivation is promoted by applying autonomy, competence, and relatedness to maintain long-lasting engagement and academic achievement [28].

1.5. Research objectives

To examine the relationship between SDT-based psychological needs and cognitive engagement.

To evaluate the mediating role of intrinsic motivation.

To compare the effects of intrinsic vs extrinsic motivation on engagement.

1.6. Research questions

RQ1: How does intrinsic motivation influence students' cognitive engagement in academic settings?

RQ2: What role do the basic psychological needs of autonomy, competence, and relatedness play in shaping intrinsic motivation?

RQ3: How does satisfaction of psychological needs indirectly affect cognitive engagement through intrinsic motivation?

1.7. Hypotheses

H1: Cognitive engagement is positively predicted by intrinsic motivation.

H2: There is a positive relationship between autonomy satisfaction and intrinsic motivation.

H3: Intrinsic motivation positively predicts competence satisfaction.

H4: There is a positive relationship between relatedness satisfaction and intrinsic motivation.

H5: There is a mediation between psychological need satisfaction and cognitive engagement through intrinsic motivation.

1.8. Integration with other motivation theories

Although this paper focuses on Self-Determination Theory, it does not ignore the complementary knowledge of:

Expectancy-Value Theory: The theory of engagement of students, lies on expectations of success and value of task [29].

Achievement Goal Theory: It emphasizes on the learning/mastery vs performance goals and their effects on engagement [30].

The combination of these theories improves our knowledge of the interaction between psychological needs, task value, and goal orientation to determine the behavior of students.

2. Materials and methods

2.1. Research design

A mixed-method research design will be employed in this research paper, which means that it will be quantitative and qualitative research at the same time. The quantitative section will be a survey where the motivation level and the level of cognitive engagement will be measured and the qualitative section will be semi-structured interviews where a stronger insight will be acquired on the experiences of the students.

This study followed a convergent mixed-methods design, where quantitative and qualitative data were collected simultaneously, analyzed independently, and then merged during interpretation to triangulate findings and enhance validity.

2.1.1. Participants

The participants in the study will be 200 students in two universities, one in an urban area and the other in rural area. The age of the participants will be 18-25 years, and both males and female students will be incorporated.

Participants were selected using stratified random sampling, ensuring representation across gender (52% female, 48% male), major (Education, Psychology, and Social Sciences), and academic year (1st–4th year). This design ensures balanced views across various educational experiences.

2.1.2. Instruments

- Motivation: Refers to internal and external drivers behind students' learning behavior.
- Psychological Need Satisfaction: The degree to which students perceive autonomy, competence, and relatedness.
- Cognitive Engagement: The extent of students' psychological investment in learning, including effort, strategy use, and persistence.

It will rely on the Motivation Assessment Scale [31], which will have its questions grounded on three fundamental components of Self-Determination Theory. The respondents will answer every statement by stating their degree of disagreement or agreement with it on a 7 point Likert scale (1 strongly disagree, 7 strongly agree) [32].

2.1.3. Reliability and validity

- Cronbach's alpha coefficients were: Intrinsic Motivation (.87), Autonomy (.85), Competence (.84), Relatedness (.82), Cognitive Engagement (.89).
- KMO = .78, Bartlett's test of sphericity: $\chi^2(210) = 1542.32$, $p < .001$.
- A Confirmatory Factor Analysis (CFA) confirmed construct validity (RMSEA = .06, CFI = .94, TLI = .92).

2.2. Questionnaire Cognitive Engagement Questionnaire (CEQ)

The Cognitive Engagement Questionnaire (CEQ) was constructed [33]. This tool measures the level to which the students react to deep learning strategies such as critical thinking, self-regulation, and effortful processing. CEG also includes self-report and behavior-related questions, which determine the level of cognitive engagement of the students in classroom activities. The 7-point Likert scale is also used to construct the questionnaire.

2.2.1. Semi-structured interviews

The supplement to the survey data was done by interviewing a sample of 30 students using semi-structured interviews. The participants of the survey selected these students randomly. The interviews aimed at delving deeper into the experiences of the students as it relates to motivation and cognitive engagement with the students and their perceptions of autonomy, competence and relatedness as being present in the learning environment.

Interviewees were selected using purposive stratified sampling based on major and year of study. Interviews continued until thematic saturation was reached (no new themes after 27 interviews). Two coders independently coded transcripts; Cohen's $\kappa = 0.82$ indicates strong inter-rater reliability.

Some of the questions in the interview protocol were

- What is your perception of your degree of autonomy in learning activities?
- What is one instance in which you were especially inspired or interested in your studying?
- What are some of the support or relationships that keep you involved with learning activities

2.3. Data collection procedure

2.3.1. Survey administration

The Motivation Assessment Scale (MAS) and the Cognitive Engagement Questionnaire (CEQ) were to be conducted as an online survey through an online survey platform. The surveys were given at the start of the academic semester so that the answers of the respondents were based on their base levels of engagement and motivation.

Participants received an introductory email testifying of the purpose of the study, the voluntary character of the participation, and the approximate time required to fill in both questionnaires (not more than 30 minutes). The participants were given an electronic consent prior to the study.

2.3.2. Interview procedure

After the survey, a group of respondents was reached out to and invited to participate in the semi-structured interviews. The interviews were either done through in-person interviews or video conferencing depending on the preference of the participant. The duration of each interview was about 30-45 minutes. All the interviews were audio-taped, transcribed, and evaluated in terms of recurring themes associated with motivation and cognitive engagement as well as the satisfaction of psychological needs.

2.4. Data analysis

2.4.1. Quantitative analysis

Descriptive statistics (mean scores, standard deviations) were used in analyzing the survey data of the Motivation Assessment Scale (MAS) and the Cognitive Engagement Questionnaire (CEQ) to summarize the motivation and engagement rates of the participants. The correlational analysis (r of Pearson) was conducted to check the correlation between intrinsic motivation and cognitive engagement and academic performance. Also, a multiple regression analysis was performed to determine the predictive validity of motivation (autonomy, competence and relatedness) on the cognitive engagement. The transcripts of the interview were analyzed with the help of thematic analysis. The initial coding of the transcripts was done on the recurring themes in accordance to the psychological needs that are classified in the Self-Determination Theory: autonomy, competence, and relatedness. The transcripts were read and re-read and thematic patterns established and coded in big themes to show how the students got motivated and the degree of engagement. A qualitative data was subsequently triangulated with the quantitative findings to achieve cumulative representation of the findings.

2.5. Ethical considerations

The institutional review board (IRB) offered the ethics that were adhered to in this study. All the participants signed a written consent and were informed of their right to withdraw out of the study as they deem fit without reproach. The obtained information was anonymized to ensure the privacy of the

respondents. All information like survey information, interview information were safely stored and only viewed by the research team. The study focused on ethical issues like confidentiality and voluntary participation.

3. Results

The findings of this research offer information about the correlation among motivation, cognitive engagement, and satisfaction of the psychological needs in learning environments. The survey data (quantitative) and interviews (qualitative) is given below.

3.1. Descriptive Statistics

Motivation Assessment Scale (MAS) and Cognitive Engagement Questionnaire (CEQ) were the survey tools, which were filled out amid 200 participants. Each scale calculated descriptive statistics to give the description of the motivation and engagement level of students.

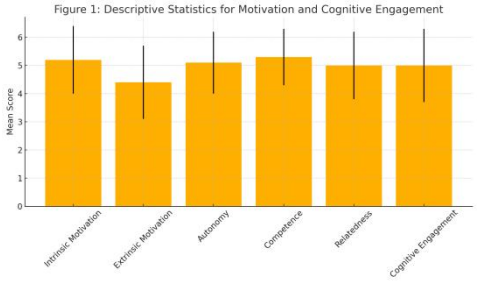

Figure 1. Descriptive Statistics for Motivation and Cognitive Engagement

In this figure 1, the average mean scores of intrinsic motivation, extrinsic motivation, autonomy, competence, relatedness and cognitive engagement are displayed with their standard deviations respectively.

Table 1. Descriptive Statistics for Key Variables

Variable	Mean (M)	Std. Deviation (SD)	Min	Max
Intrinsic Motivation	5.2	1.2	1	7
Extrinsic Motivation	4.4	1.3	1	7
Autonomy	5.1	1.1	1	7
Competence	5.3	1.0	1	7
Relatedness	5.0	1.2	1	7
Cognitive Engagement	5.0	1.3	1	7

Table 1 shows the descriptive statistics of all the significant study variables, such as motivation constructs (intrinsic and extrinsic), the three psychological needs (autonomy, competence, relatedness) and cognitive engagement. The findings show that the responses of the participants yielded moderate to high scores in all of the variables, which implies that the student sample is characterized by rather positive motivational and engagement profiles.

3.2. Motivation Assessment Scale (MAS)

- **Intrinsic Motivation:** The mean of intrinsic motivation was 5.2 (SD=1.2) out of their potential maximum of 7 that indicated moderate and high intrinsic motivation in the participants.

- **Extrinsic Motivation:** The mean scores of extrinsic motivation were 4.4 (SD = 1.3), which means that the students were moderately motivated to the extrinsic stimuli (grades or recognition).
- **Psychological Needs:** The average scores of the autonomy showed were 5.1 (SD = 1.1), competence were 5.3 (SD = 1.0), and relatedness was 5.0 (SD = 1.2) which implied that the participants believed that their psychological needs were moderately met in their learning environment.

The respondent is required to complete a questionnaire on the topic of cognitive engagement (CEQ).

The mean score of the cognitive engagement was 5.0 (SD = 1.3) which meant that there was moderate engagement in learning activities. This score shows that students were fairly interested though there is a way on how to improve their cognitive involvement in learning activities.

3.3. Cognitive Engagement Questionnaire (CEQ)

The cognitive engagement mean score was 5.0 (SD = 1.3) indicating that there was moderate engagement in learning activities. This score indicates that students were moderately engaged, but there can be a way of enhancing their cognitive engagement in learning activities.

3.3.1. Correlational Analysis

Pearson correlation aided in the investigation of the relations between the intrinsic motivation, extrinsic motivation, cognitive engagement and the satisfaction of the psychological needs.

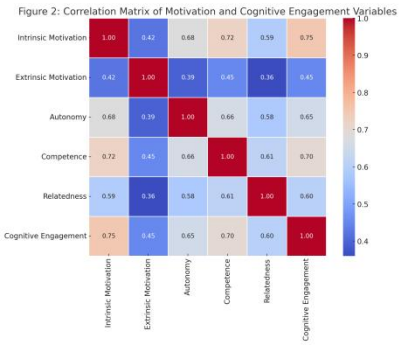

Figure 2. Correlational Analysis between Motivation and Cognitive Engagement

Figure 2 shows the Pearson correlation coefficients of the six key variables of the study, namely intrinsic motivation, extrinsic motivation, autonomy, competence, relatedness and cognitive engagement. Positive correlations that are stronger are represented by warmer colors. It is worth noting that intrinsic motivation has the most positive correlation with cognitive engagement (r =.75), then competence (r =.70) and autonomy (r =.65). All correlations are statistically significant, at p <.01, which indicates that motivational constructs and engagement have strong interrelationships.

The values of correlation coefficients (r values) as presented in this graph depict the strength of the relations.

The correlational analysis has yielded the following most noticeable findings:

- **Intrinsic Motivation and Cognitive Engagement:** There was a high positive relationship between intrinsic motivation and cognitive engagement (r = 0.75, p = 0.01). It implies that the more intrinsically motivated students were, the more they were cognitively involved in their learning activities.

- **Extrinsic Motivation and Cognitive Engagement:** The extrinsic motivation had a moderate positive relationship with the cognitive engagement ($r = 0.45$, $p < 0.01$). This would imply that the extrinsic motivation is also applicable in engagement, just that it is not correlated with extrinsic motivation as the extrinsic motivation.
- **Relatedness and Cognitive Engagement:** relatedness and Cognitive Engagement had a moderate positive correlation ($r = 0.60$, $p < 0.01$), meaning, that positive relationships with teachers and peers are related to the higher level of cognitive engagement.

3.3.2. Correlational Analysis

Table 2. Pearson Correlations Among Study Variables

Variable	1	2	3	4	5	6
1. Intrinsic Motivation	1					
2. Extrinsic Motivation	0.42	1				
3. Autonomy	0.68	0.39	1			
4. Competence	0.72	0.45	0.66	1		
5. Relatedness	0.59	0.36	0.58	0.61	1	
6. Cognitive Engagement	0.75	0.45	0.65	0.70	0.60	1

Note: p < .01

Table 2 shows the intercorrelations of all variables of the study. Autonomy, competence, relatedness and cognitive engagement were positively correlated with intrinsic motivation. Meanwhile, extrinsic motivation showed moderate correlation with the remaining variables. These findings indicate that natural types of motivation are better oriented towards profound mental engagement in activities of learning.

Table: (Note: p <.01 on all significant correlations.)

3.4. Regression analysis

The level of cognitive engagement was determined by multiple regression analysis in the predictive values of intrinsic and extrinsic motivation and the realizations of the three psychological needs (autonomy, competence, and relatedness).

The value of VIF was less than 2.5, which means that there was no multicollinearity.

The plots of residuums did not indicate significant deviations of normality.

The homoscedasticity was tested with Breusch-Pagan test ($p > 0.05$).

Table 3. Multiple Regression Predicting Cognitive Engagement

Predictor	β	SE	t	p
Intrinsic Motivation	0.49	0.07	7.00	< .001
Autonomy	0.27	0.06	4.50	< .001
Competence	0.30	0.06	5.00	< .001
Relatedness	0.12	0.07	1.80	.073
Model R^2	.53			
F(4, 195)				45.12, p < .001

The table 3 is the summary of the multiple regression analysis performed to establish the predictive value of intrinsic motivation, autonomy, competence and relatedness on cognitive engagement. The model accounted 53 percent of the cognitive engagement variation (R2 =.53, p <.001). Among the many positive predictors, intrinsic motivation, competence and autonomy were significant predictors, and there was a weak relationship effect of predictor relatedness. This is the primary focus on the significance of intrinsic motivation and perceived ability to increase a deeper engagement.

3.5. Qualitative data analysis

Those who were regularly assessed on their performance and had opportunities to develop their skills felt more confident in what they were learning and stayed engaged. One participant noted: Once I receive feedback about my work, I feel motivated to develop and work harder on my work.

3.6. Relatedness and support

Good peer and instructor relations were also regarded as important factors in the preservation of motivation and interest. Students that had positive experiences with their teachers and with their peers were more prone to remain engaged in the learning process.

4. Discussion

4.1. Interpretation of findings

This research incorporates SDT, although it assumes that competence and autonomy have differentiated mediating roles in the formation of intrinsic motivation among academic disciplines. It is also more cross-theoretical as it provides a more multifaceted perspective on the study of motivation psychology.

This observation goes hand in hand with the results of other researchers who highlighted that intrinsic motivation is among the determinants that facilitate the deep, deep, and meaningful engagement of activities that are connected to education. Not only do intrinsically motivated students stand a better chance of liking the learning process, but they are also more likely have critical thinking, problem solving and self-regulation that are other important elements of cognitive engagement [34].

The process of cognitive engagement is usually associated with deep learning approaches and strategies that expect students to move past the surface-level memorization of the content and, instead, engage actively with the information by analyzing, synthesizing, and practicing the knowledge they have learned. Students who are intrinsically motivated tend to embrace more of these deep learning strategies since they are not motivated by the need to be rewarded by external sources but by the fact that they have a genuine interest in the topic. An example of this would be an intrinsically motivated student studying environmental science and goes beyond the textbook to research or participate in an extracurricular activity related to the subject showing greater cognitive engagement.

Besides, the findings of the multiple regression analysis (Model 1) indicate that intrinsic motivation, as well as the satisfaction of the psychological needs of autonomy, competence, and relatedness are significant predictors of cognitive engagement. The greatest predictive value was recorded on competence (B = 0.30, p < 0.01) and autonomy (B = 0.27, p < 0.01), which is consistent with SDT claim that the two needs are critical in promoting intrinsic motivation and involvement. A learner will feel more motivated to go into the details of the materials when they feel good about their capacity and the ability to control their learning because, under such circumstances, they have a feeling of self-efficacy and mastery. That is consistent with the contributions of Bandura (1997) who suggested that the feeling of competence and mastery would breed self-

confidence and urge a person to soldier on in the face of adversity, thus sustaining the high levels of cognitive engagement.

Cognitive engagement cannot develop without the significance of autonomy. The aspect of autonomy or the desire of the students to feel that they have control over their learning decision is especially critical in fostering intrinsic motivation. The students will be more willing to get involved in the learning process when they feel that they have a voice in learning i.e. when they get to choose the topics to use in their assignments or when they have a say on how they want to approach the tasks. Autonomy-supportive conditions result into increased intrinsic motivation as well as increased cognitive interest. As an example, a student that has the option to select a project that suits their own interests will be better motivated and have interest in completing the task than a case where the student is forced to do a topic that they are not interested.

The moderate level of correlation that exists between relatedness and cognitive engagement ($r = 0.60$, $p < 0.01$) indicates that although relatedness is important it is not as predictive of cognitive engagement as autonomy and competence. Nevertheless, it remains a major source of engagement. This observation demonstrates why social interactions and emotional support are critical in the educational setting that students need to feel connected and supported by others. The more positive the relationships that the students have with both the peers as well as the instructors, the more motivated and engaged the students will be because these circumstances give them a sense of belonging and a sense of validation.

The students who feel that their teachers care and are helpful tend to be more motivated and interested in the learning process. The results of the current study are in line with this idea, as it implies that students who experience the feeling of belonging and social support in the classroom environment are more likely to immerse themselves in the content. It should be noticed though that although relatedness is imperative in terms of engagement, it might be less relevant in individual learning situations but more relevant in motivating learning situations that are more collaborative like group projects or interactive classroom settings.

Interestingly enough, extrinsic motivation was also reported to be correlated with cognitive engagement in a less strong, yet significant ($r = 0.45$, $p < 0.01$) way.

This supports the idea that while extrinsic rewards, such as grades and recognition, can motivate students to some extent, they work similarly to intrinsic motivation. Too much dependence on extrinsic rewards in fact negates intrinsic motivation a phenomenon referred to as the overjustification effect. Although extrinsic motivation was found to be a predictor of student engagement in this study, intrinsic motivation and the psychological needs identified by Self-Determination Theory (SDT) proved to be by far stronger predictors. This corresponds to a general trend in the literature: extrinsic rewards may contribute to short-term commitment, but not long-term engagement and further learning. In teaching, grades can also be employed as a motivational tool, but that can actually backfire, and students may get more preoccupied with getting a reward than actually learning.

This will result in a decline of intrinsic motivation in the future. In clarifying this point, when learners are repeatedly rewarded on their performance, they might be tempted to start perceiving learning as the end, rather than a personal development and thought process.

The literature at hand indicates that extrinsic motivation may also play a role in the facilitation of engagement, however, it should not be the primary driver of student effort as it may inhibit the degree of cognitive engagement, and it may inhibit the development of intrinsic motivation.

The findings of the study support the reality that the influence of an extrinsic motivation and fulfillment of the basic psychological needs is obligatory in the expression of mental activity. Relatability can also be driven by giving the students a chance to connect with their classmates significantly to make them feel more connected to the community in the classroom.

4.2. Implications for education

Besides that, there is also a need to provide students with an opportunity to become competent by presenting them with challenging problems and providing positive feedback.

As soon as students are sure that they are strong enough in their abilities, they will be more willing to access the material and will do it even in the face of a challenge. This can be through the provision of tasks that are adequately challenging and regularly and formative feedback that assists the student in improving not just skills, but cognition of their progress.

It should also be seen to provide a positive classroom atmosphere whereby students feel included in the other students and teachers to foster motivation and interest. The interviews revealed that students who reported that they had good relationships with teachers and peers were more motivated and concerned with their learning. In this regard, teachers should focus on cultivation of classroom culture founded on co-operation, respect, and emotional support.

Although intrinsic motivation is probably the essential component of long-term cognitive engagement, extrinsic motivation cannot be completely rejected. Extrinsic rewards like grades and recognition are sometimes effective in some situations especially when the students are new to the concepts and skills being taught. These rewards must however be applied in a sensible manner and should not shadow the inherent worth of the learning process itself. Teachers need to pay attention to the combination of both intrinsic and extrinsic motivation approaches to establish a successful learning process.

4.3. Cultural and contextual considerations

The collectivist orientation in many Asian academic cultures may moderate the relationship between autonomy and motivation. While autonomy is emphasized in SDT, its expression may vary across cultures—suggesting the need for culturally adapted instructional strategies.

4.4. Limitations of the study

Although the results of this research are important, there are some drawbacks which are to be taken into account. To begin with, the study has used self-report measures on motivation and cognitive engagement. Although these tools are usually applied in the sphere of educational research, self-reports may suffer social desirability bias or wrong perceptions of engagement. The future studies might be improved by using the observational approach or teacher ratings of cognitive engagement as this would give a more objective measure. Moreover, the research was in a given context having a relatively homogenous sample of undergraduate students. The applicability of the results to other levels of education, including secondary school or graduate students, might be weak. Research on how motivation-cognitive engagement relationship differs between various age groups and educational settings should be done in the future.

Lastly, the research revealed the significance of the three needs: autonomy, competence, and relatedness, in stimulating motivation and engagement; however, it failed to identify interaction between the three needs and other individual differences including personality traits or academic performance in the past. The way individual factors (self-regulation skills, or prior knowledge) mediate the connection between motivation and cognitive engagement could be explored in future research.

4.5. Future research directions

Further research can be done on how cultural differences affect the connection between motivation and cognitive engagement. Perhaps, the significance of autonomy, competence and relatedness can be affected by various cultural settings whereby one culture may emphasise on collective learning and relatedness whereas other cultures may focus on individual accomplishment and autonomy.

In addition, longitudinal studies may be conducted to investigate the role of modifications in motivation and cognitive engagement with time and academic achievement and learning outcomes. The insights into the development of these aspects during the academic career of a student may assist teachers in creating specific intervention programs that will foster a long-term engagement and motivation.

The digital learning environments are another avenue that has potential in future studies. Since the usage of online learning platforms and hybrid types of education is on the rise, it would be worthwhile to explore the effects of motivation and cognitive engagement based on the design and arrangement of digital classrooms. In particular, one or another research might be directed to study the possibility to cover the psychological needs of students with online courses and ensure the development of intrinsic motivation despite the remote learning environment.

5. Conclusion

The purpose of the research was to determine how cognitive engagement and motivation are connected to one another in the educational process, with a reference to the psychological needs of the Self-Determination Theory (SDT). The findings were strong proof that intrinsic motivation is an important factor that contributes to cognitive engagement among the students. Namely, the satisfaction of the three fundamental psychological needs that included autonomy, competence, and relatedness was revealed to have a positive effect on motivation and cognitive engagement, which is consistent with the fundamental concepts of SDT.

In our results we highlight the fact that students in their learning settings experience more autonomy when they are confident regarding their academic experiences and have a significant connection with those around them, teachers and peers they will tend to explore more deeply into the learning content. All these, coupled with other factors do not only make the students participate in their learning process, but also enhance their thinking process in the learning process which leads them to better performance in the academics besides having a better understanding of the information that they were studying. The fact that intrinsic motivation is positively related to cognitive engagement supports the necessity to increase intrinsic forms of motivation as compared to extrinsic rewards, which were found to impact engagement more poorly.

The research has implications to the educational practice. The teachers are proposed to create learning environments that would meet the psychological needs of the learners, provide them with freedom of choice, challenge as well as positive relationships with each other. By the independence, sufficient challenges to generate a feeling of competence, good interpersonal relationships, teachers will be able to raise the student drive and interest and this will lead to a more productive and significant learning process.

Nevertheless, although this study is a contribution to the body of research on motivation and engagement, it also gives several areas on which future research can be conducted. Future studies ought to explore the interaction of these motivational elements under various educational settings such as within the secondary school, graduate school and online learning. Moreover, the idea of the role of individual differences, including personality traits and previous academic performance, would offer more information on the way motivation and engagement differ between students.

Finally, the research results of the given study point to the importance of motivation as a factor in optimizing the process of cognitive engagement in the educational environment. With the knowledge of the Self-Determination Theory, teachers can establish the environments that do not only help facilitation of motivation but also provide the deep cognitive engagement which leads to academic success and the lifelong learning achievements.

Author Contributions

The published version of the manuscript has been checked and accepted all by the authors.

Conflict of interest

The authors declare no conflict of interest

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Appendix

Appendix A: Survey Instruments

Motivation Assessment Scale (MAS)

Sample items:

- I enjoy learning new material for its own sake (Intrinsic Motivation).
- I work hard to get good grades (Extrinsic Motivation).
- I feel I have control over how I learn (Autonomy).
- I believe I am capable of succeeding in this subject (Competence).
- I feel connected to my classmates and teachers (Relatedness).

Cognitive Engagement Questionnaire (CEQ)

The Cognitive Engagement Questionnaire (CEQ) was used to measure the degree to which students engage cognitively with their learning tasks. This instrument captures aspects such as effort, persistence, and self-regulation during learning activities. Items were rated on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

Sample items:

- I often think deeply about the material in this course.
- I try to make connections between the new content and what I already know.
- I use strategies to help me remember information for exams.
- I feel challenged by the learning tasks in this course.

Appendix B: Interview Protocol

The following set of semi-structured interview questions was used to capture the qualitative data from students regarding their experiences with motivation and cognitive engagement in the classroom.

- How do you feel about the level of autonomy you have in your learning activities (e.g., choice of topics, methods of assessment)?
- Can you describe a situation where you felt particularly motivated or engaged in your studies? What factors contributed to that?
- What strategies do you use when you find a subject difficult or uninteresting?
- How important is it for you to feel competent and successful in your academic tasks? Can you provide examples of when you felt either competent or incompetent?
- How do your relationships with classmates and instructors impact your motivation and engagement with the course material?