



Actively Open-Minded Thinking, Personality and Critical Thinking in Spanish Adolescents: A Correlational and Predictive Study

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Actively open-minded thinking (AOT) is a crucial aspect in the education of adolescents; however, it has been insufficiently researched in the Spanish context. The purpose of this study is to analyse AOT and its relationship to critical thinking skills and personality. The participants in this research comprise 877 Spanish secondary school students. The study design is multidisciplinary, correlational and predictive. The findings show that personality traits, especially honesty, empathy and solidarity, and critical thinking skills, the development of new knowledge, analytical skills, and not learning by memory, are directly related to AOT. Actively open-minded thinking is the synapse of critical thinking because it allows for the achievement of objectives, reflection on and/or consideration of alternatives before making decisions. It is concluded that AOT is significantly related to the projection and value of critical thinking skills. Personality traits as well as identified competences can be used to integrate specific skills of both kinds of thinking into the educational curriculum.

Keywords: actively open-minded thinking, critical thinking, personality, secondary education, adolescence

INTRODUCTION

The importance of actively open-minded thinking (AOT) and critical thinking has been prolifically researched as they are viewed as essential skills in Higher Education students (Cloete, 2018; Straková & Cimermanová, 2018; Zelaieta & Camino, 2018). However, similar kinds of studies about these types of thinking in adolescents, and their integration into the educational curriculum, have been scarcely researched in an international context, especially in Spain.

Adolescence is a stage during which an individual experiences multiple social, physical, personal, and psychological changes (Crocetti, 2018). This development stage, where

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there is a confrontation between the two contrary forces of trust-mistrust and distrust, could be solved through the development of AOT and critical thinking, since they provide individual (more stability and security), academic (an increase in academic performance and a deeper understanding of the contents), employment (successful professional development), and social (being more aware citizens and experiencing true freedom) benefits.

Baron (1991) argues that individuals think according to certain standards and are not aware of the degree of validity of their thinking and, in fact, they believe they think well. The author defends the Theory of Good Thinking, which mainly refers to how human beings are capable of facing objectives, doubts, problems, and challenges which oblige them to position themselves and make decisions; that is to say, how individuals manage information, how they filter and prioritize it, and how they incorporate it into their personal and professional experience. He argues that conscious thought occurs when there is a state of doubt about what to do or believe and that uncertainty and controversy motivate deep thought (Baron, 1994). In this study, AOT is understood as reflective thinking and includes the tendency to contemplate new tests and consider other people's opinions before reaching a final decision (Svedholm-Häkkinen & Lindeman, 2018). It is a style of thinking and a disposition to think in a particular way, which assesses and evaluates arguments and evidence with less susceptibility to the bias of one's own previous beliefs (Heijltjes et al., 2015). This relative immunity to excessive trust in previous beliefs could increase the open-mind thinker's wish to be better informed before estimating or predicting, thus managing to make better decisions (Stanovich & West, 1997).

Critical thinking, on the other hand, is a more comprehensive concept that involves disposition (the affective aspect) and skills (the cognitive aspect) (Ennis, 2011; OECD, 2018; Shaw et al., 2020; World Economic Forum, 2015). Disposition refers to each person's attitudes, such as wanting to be well, and sensitivity towards beliefs, feelings, and the knowledge of others. Skills refer to the cognitive aspects which are necessary in order to think critically, such as analysis, interpretation, reflection, inference, explanation, self-regulation, research, and judgment. Ennis (2015) identifies critical thinking as "a kind of reasonable and reflective thinking which focuses on deciding what to believe and do" (p. 32). Hogan et al. (2015), Parrott and Rubinstein (2015), and Maynes (2017) added that metacognitive competencies and epistemological assessment are essential in order to develop critical thinking; that is to say, thinking about what one is thinking. This implies that such high-level cognitive competences (e.g., planning, controlling, debugging, evaluating, monitoring and analysing) enable a person to self-regulate his or her learning and gain autonomy, such as learning how to learn. This is central to quality learning (Mahanal et al., 2019).

Miftahul et al. (2017) outlined as an essential feature of critical thinkers the willingness to reason and from points of view with which they disagree, without letting the disagreement interfere in their reasoning. Critical thinkers have the ability to accept the statements as true, even when these statements do not agree with their own position. This approach is not discordant with critical thinking, nor is it simply a statement of

intent; on the contrary, it is a central aspect of a critical thinking process. Every person needs to be open to other people's arguments and to allow them to influence their own beliefs, if they are good arguments. This way, the majority of people have the potential to develop and learn thinking skills which are more efficient than the ones they have, and to help them improve their performance in diverse circumstances (Yue et al., 2017).

In regard to the relationship between AOT and critical thinking, Baron (2019) stated that AOT is not only critical thinking, as the term suggests a sceptical attitude, which can make critical thinkers doubt something even when they should believe it. On the contrary, this author argues that AOT implies understanding and trust. In addition, Janseen et al. (2020) have proven that AOT is an important measure when conducting research on reasoning and decision making. Recently, in a mixed study with 1551 American adolescents, Metz et al. (2020) showed that the adolescents had a high command of the ability for AOT, especially in relation to the search for new ideas, epistemic empathy, and pluralist thinking. AOT is thus one of the central axes of advanced epistemic thinking. In fact, a high command of AOT may predict the ability to solve those tasks in which critical thinking is involved.

The preceding arguments show how AOT and critical thinking support and reinforce each other, that they are conceptually coherent and organized, and persistently creative and flexible. That is why it is relevant to promote these skills in the classroom. With both kinds of thinking it is possible to reduce bias, broaden the scope, contrast information, reconsider beliefs, and reach conclusions which go further than the starting point.

Nevertheless, modelling the skills from AOT and critical thinking requires a significant effort and its achievement implies training for an extended period of time. In this sense, the academic and scientific community have shown the need to find specific strategies in order to develop both skills linked to AOT (such as knowing how to listen, curiosity, valuing tests, and considering other people's opinions) and critical thinking skills (analysing, interpreting, explaining, researching, deducing, and judging), and they are interested in knowing which of those competencies is more important than the others (As'ari et al., 2019). This study hopes to contribute to solving such difficulties.

The Development of Critical Thinking and AOT in Secondary Education in Spain

Secondary education (ESO) in Spain is an obligatory and free stage which, together with Primary Education, constitutes Basic Education. It consists of four academic years between the ages of 12 and 16. ESO is organized in two cycles; the first consists of three school years (1st, 2nd and 3rd ESO), the second of one (4th ESO). After the latter, pupils have two options: taking the Baccalaureate or Vocational Education and Training (LOMLOE, 2020). For a very long time, the traditional education system has emphasized the transmission of knowledge at this educational stage. In Spain, the modification of the educational curriculum oriented to the development of competencies has not had the desired results. Lately, these changes and society's needs, such as rapid technological development, a knowledge society, economic globalization, and a higher cultural diversity in cities (Bastante-Ceca et al., 2020) have motivated the creation of a

new educational model, centred on constructive learning (O'Connor, 2020). The objectives of this type of learning are to encourage students' participation and autonomy, and collaborative work (such as project-based, problem solving, or cooperative learning). However, this active model has not meant any essential changes in the methodological orientation. The situation is similar to the 1990s, with a kind of teaching based on a pedagogical approach oriented to content and towards the acquisition of knowledge, which emphasizes the command of subjects and does not promote the development of flexible, reflexive, and creative thinking.

In the last few years, some Spanish educators have emphasized gamification (Cotta et al., 2018; Teixes, 2015), which implies the use of game theory and mechanics in order to involve and motivate students. Through gamification they try to turn the routine of the classroom into an attractive, dynamic, motivational and fun activity (Villalustre & del Moral, 2015). However, it has been shown that, in many cases, this way of teaching has resulted in lessons which were exclusively fun, simplistic, excessively facilitating, and demanding little, as students are distracted by the game, waste time, develop a limited level of oral expression, become demotivated after they have overcome the initial novelty, and fail to achieve a balance between playfulness and learning (Roa et al., 2021).

In short, despite the prevalence of the use of active methodologies, and the fact that critical thinking is included as one of the objectives of Spanish education, the education system has provided a tenuous response and has not made a clear commitment to teaching this type of thinking in secondary education. Students continue to acquire a knowledge of concepts that is deficient, superficial, and based on repetition (Albertos & De la Herrán, 2018), where the correct answer continues to be the central focus of the grade and the concern of students, parents and teachers alike. Heuristic and metacognitive strategies that can be applied are scarce and beliefs, facts and habits are still taught, but not reflections or challenges, which limits and conditions the development of critical thinking. The situation is further exacerbated because adolescents' willingness to open their minds to experiences, beliefs, values and perspectives that differ from their own is not developed (Kwong, 2016); that is, they are not taught to weigh new evidence that may contradict or corroborate their own beliefs. As a result, individuals who are not flexible in their belief systems and who are not able to recognize that they can be wrong are formed.

The preceding arguments suggest the need to use teaching-learning active methodologies aimed at promoting AOT and critical thinking. Both types of thinking are fundamental in education, not only because it is about the formation of certain critical skills or competences, but also because the formation of actively open-minded and critical thinkers is an ethical and moral responsibility of education (Standish & Thoilliez, 2018). Despite this, the focus of academia has been on critical thinking in particular. Along these lines, Siegel (2017) defended the following reasons which justify the importance of critical thinking from the ethical and moral dimension: (1) the principle of respecting people requires that we understand them as capable of thinking critically and that we promote their abilities. Students have the right to think, question,

challenge and seek answers, and they have those rights in the classroom; (2) critical thinking is necessary when preparing students for adult life. New generations need to be capable of making judgments and opinions, as well as their feelings and emotions, in an independent manner; (3) critical thinking plays a central role in higher intellectual activities, as it promotes information processing and analysis strategies (Basri, 2019; Burbules, 2016; Pretorius, et al., 2017). Finally, (4) critical thinking is relevant for continuing students' democratic and civic training, as critical thinkers are expected to be good citizens, able to fully and consciously participate in and contribute to the democratic society in which they live. However, AOT is even more efficient and productive, as it develops the ability to seek out evidence contrary to what one already has, as well as actively processing it (Stenhouse et al., 2018). This could contribute to shaping individuals and citizens who have a moral responsibility to observe and modify normative laws and ideas, and thus to build actively open-minded societies based on freedom (Bar-Tal et al., 2020).

Personality and Critical Thinking

Some researchers (for example, Changwong et al., 2018; Siavoshifar, 2015) have emphasized academic skills, gender, and personality types as factors which can significantly influence the development of critical thinking in adolescents. Academic skills are key to success and include aspects from time management, organizing a schedule, to the studying techniques which students use. In the research carried out by Sulistiana et al. (2013), they inquired into the relationship between gender and motivation, and concluded that women have a higher value than men in terms of critical thinking skills. Women are better qualified than men to draw conclusions, which means that they are better able to formulate hypotheses and select and analyse information (Rosidin et al., 2019). Likewise, the learning process is influenced by internal factors, typical of students, which make up their personality, which in turn is defined as the holistic and dynamic organization that determines thinking, behaviour, and the adaptation of the individual to their environment.

Very few psychologists have tried to understand the differences in personality between those who think critically and those who do not. Along that same line, Siavoshifar (2015) has concluded that personality features and metacognition predict critical thinking. Meanwhile, Van Aaldren-Smeets and Walma van der Molen (2013) showed that teachers' personal attitudes towards science positively influence their professional attitudes towards teaching itself. Thus, in order to achieve potentially effective learning, it is necessary to identify which of the students' personal attitudes are related to the development of critical thinking.

In a sample of 240 university students, Soleimanifar et al. (2015), analysed the relationship between learning styles, metacognition, and critical thinking. The most significant findings of this study showed that openness to experimentation ($\beta = 0.41$), conscience ($\beta = 0.41$), abstract conceptualization ($\beta = 0.39$), active experimentation ($\beta = 0.22$), reflexive observation ($\beta = 0.12$), cognitive knowledge ($\beta = 0.47$), and cognitive regulation ($\beta=0.29$) were efficient in the prediction of critical thinking. They also proved that openness to experimentation and conscience ($r^2 = 0.25$), active experimentation,

abstract conceptualization, and reflexive learning styles ($r^2 = 0.21$), and metacognitive regulation ($r^2 = 0.3$) had a relevant role in critical thinking. Likewise, Barhaghtalab and Sharafi (2016) argued that personality is directly and significantly related to critical thinking skills and found that those with high neuroticism scores have problems when critically analysing a topic. Recently, in a study of 400 university students, Orluwene and Okoye (2020) proved that the highest scores in some personality traits predict the highest critical thinking skills. Those students with an AOT and a positive personal attitude have more and better possibilities for developing critical thinking skills in a more effective and efficient way. In that regard, Takahashi et al. (2016) revealed that a higher extroversion, openness to experiences, and conscience are closely linked to critical thinking skills. Based on the abovementioned references, the general objective of this study was to analyse secondary education students' AOT and its relation to critical thinking skills and personality. The following hypotheses are proposed:

Hypothesis H1: a positive and statistically significant relationship exists between AOT and adolescents' critical thinking skills and personality traits.

Hypothesis H2: critical thinking skills and personality traits are predictors similar to AOT.

METHOD

Data Analysis and Design

The study is multidisciplinary, correlational, and predictive. The variable "actively open-minded thinking" has been used as a criterion variable, relating it to the variables "critical thinking skills" and "personality traits". The study is expected to reveal significant correlations between AOT and the variables of critical thinking skills and personality. The software used for the analysis of data is SPSS. v. 26.

Participants

The technique used for data collection is convenience sampling. The sample was made up of 877 students from the first cycle of secondary education (equivalent to Middle School or Junior High School in the USA). In Spain this is an obligatory stage, fee-free, and completes Primary Education, which is formed by a three-year first cycle and a one-year second cycle.

The sample was collected in 42 Spanish schools, 76% of which are public, 22% state-subsidized, and 1.9% private. The participants' age fluctuates between 12 and 14 years old, 66.4% of the sample being female and 33.6 % male. Of the students, 21.9% are studying in their first year, 30% their second year, and 48.1% their third year of secondary education.

Research Variables

The independent variables are grouped in two factors: (1) personality traits and (2) critical thinking skills.

The dependent, criterion, or response variable is the AOT.

Measuring Instruments

1. High School Personality Questionnaire (HSPQ)

The *High School Personality Questionnaire* created by Cattell et al. (1979) was adapted for the purpose of this study and for the participants' context. Allport and Odbert (1936) categorized the individual differences in cardinal, central and secondary traits, which were initially grouped into 171 categories, and later reduced to 45. As a result, by using the statistical technique called "factor analysis", Cattell et al. (1969) identified the related terms, reducing the list to 16 key traits: abstraction, concern, dominance, emotional stability, brightness, openness to change, perfectionism, privacy, reasoning, normative conscience, self-confidence, sensitivity, social boldness, tension, vigilance, and warmth. The adapted questionnaire was made up of 19 closed questions, valued with a 5-answer Likert Scale, between "never" (1) and "always" (5) (Table 1). The Cronbach's Alpha of the items was 0.947. Additionally, in the first part of the instrument, and in order to collect social democratic information, the following items were added: educational stage/level, sex, and type of educational centre.

Table 1
Personality traits and linked behaviours

Personality traits	Rank's elements	Number items
Normative conscience/vigilance	Fair, responsible	2
Open-mindedness	Inclusive, open	1
Enthusiasm/liveliness	Enthusiastic	1
Awareness	Impartial	1
Self-confidence	Developing positive self-confidence	1
Sensitivity/concern/warmth	Empathic, solidary, tolerant, egalitarian, affective, honest	6
Security/privacy	Demanding respect Capable of setting limits	2
Emotional balance	Balanced	1
Perfectionism	Self-demanding	1
Self-control	Self-control	1
Independence/dominance	Self-confidence, autonomous	2
TOTAL		19

2. Facione's Critical Thinking Skills Test (1990)

The instrument consisted of 10 closed-question items. Each item was valued using a 5-answer Likert Scale, which goes from "never" (1) to "always" (5). Reflexive judgment is outlined and based on 6 skills: interpretation, analysis, assessment, inference, explanation, and self-regulation (Table 2). In the same way as in the HSPQ, in order to

collect social democratic information, the following items were added: educational stage/level, sex, and type of educational centre.

Table 2
Critical thinking skills

Skills	Description	Questionnaire items
Interpretation	Understanding and expression of the meaning or procedures.	I managed to understand the subject's content.
Analysis	Identifying the inference relations.	Knowing and learning the subject's content. Not learning only by heart. Developing analytical capacity. Being critical, self-critical, and reflexive.
Assessment	Credibility of the established, perceptions, experiences, assessment of the inference relations between concepts.	Creating new knowledge and not only repeating it by heart.
Inference	Identifying and securing the elements which are required to create a reasonable conclusion, speculating and hypothesizing.	Relating the subject's contents to what happens in real life.
Explanation	Representing coherent ideas and results.	Developing the ability to explain ideas clearly.
Self-regulation	Self-conscious monitoring cognitive activity. Analytical and assessment skills.	Researching. Investigating the subject's contents outside the classroom.

Source: Created from Facione (1990, pp. 15-22).

The variable "critical thinking skills", in the analysis, had an internal consistency of 0.889 for all items.

3. Facione and Facione's (1992) Subscale of Open-Mindedness Skills

While there are instruments for measuring AOT in university students, such as the one proposed by Janssen et al. (2020), very few have been developed for secondary school students. In this study, the California Critical Thinking Dispositions Questionnaire (CCTDI) developed by Facione and Facione (1992) designed to measure AOT skills from secondary education to PhD level has been used. The following subscales of the questionnaire were considered: (1) the openness subscale: being tolerant of viewpoints, respecting the rights of others to have different opinions, being open to dialogue, and being impartial, and (2) the maturity subscale: disposition to make reflective judgments. Based on this, the following skills are integrated: respect for others, to be impartial, to be patient, to be critical, self-critical, and reflective, and to be open to dialogue (Table 3). Each item was valued using a Likert scale of 5 responses, from "never" (1) to "always" (5). In addition, the following socio-demographic information was collected: educational stage/level, gender, and type of educational centre.

Table 3
Actively open-minded thinking skills

Skills	Description	Questionnaire items
Respect for others	Acknowledges the importance of respect for others. Develops self-confidence and self-assurance.	Respect for others and their points of view.
To be impartial, to accept divergent points of view	Identifies relationships and inferences between statements, concepts and expressions.	To know and to learn the subject matter, to understand and to accept opinions.
Being patient	Controls reactions and own assessments. Credibility of established or other opinions or beliefs.	To be patient: to listen, believe and analyse the arguments of others.
To be critical, self-critical and reflective	Associates information and understands meaning at both surface and deep level. Thinks about the implications of actions.	To be self-critical, critical, and reflective. Research/inquire.
To be open to dialogue	Eliminates one-way points of view, counteracting prejudices. Creates, builds, and innovates on basis of critical dialogue.	Open-minded, open to dialogue.

After carrying out the reliability analysis, a Cronbach's Alpha has been obtained, with a value of 0.885, which implies a high correlation and homogeneity among all items of AOT. According to Vogt (2007), a value of 0.7 or higher means satisfactory in most cases, therefore it is possible to affirm that there is a great deal of internal consistency among the items of instruments.

Procedure

Initially, three researchers from the team contacted the directors of schools and an informative meeting was arranged. Once the corresponding permission for data collection was obtained, the tutors were contacted by e-mail explaining the purpose of the study. Afterwards, the students were sent both instruments through Google Forms®, which were voluntarily completed by the participants during their free time and outside class time. Some teachers/tutors allowed the participants to fill out the instruments during tutoring time, which takes place during one hour a week. The data were collected between May 2018 and March 2019. Once collected, the data were introduced in an Excel sheet and were debugged for quality control, identifying the percentage of missing values (< 5%). Subsequently, Exploratory Factor Analysis (EFA) was carried out through Principal Component Analysis, with an adjustment after oblique rotation through the Varimax method. With this analysis, three homogeneous groups of variables (components) were obtained and the processing of the information was facilitated and accelerated. In this way, its dimensionality was reduced and, above all, the maximum possible information was condensed. In short, EFA was complemented with the Confirmatory Factor Analysis (CFA), in order to decide if the number of established factors was the right one.

After observing the normality criteria of the dependent variable by means of nonparametric contrast through the Kruskal-Wallis test, it was resolved that there were not significant differences between AOT and social democratic variables (educational stage/level, sex, and type of educational centre). Later, a linear regression analysis was carried out in order to understand how personality traits and critical thinking skills affect the criterion variable AOT. The analysis was complemented with Pearson's r correlational analysis and, finally, the Chi-squared test was used to determine whether or not the observable distribution of the ordinal categorical variable conformed to a uniform distribution.

FINDINGS

Correlation between the Study Variables: Personality, Critical Thinking, and AOT

In regard to the personality dimension, the exploratory factor analysis particularly highlighted the following traits: honesty, empathy, solidarity, tolerance, equality, affectivity, inclusion, justice, having equilibrium, demanding respect, enthusiasm, self-control, and positive self-esteem, while the items which were best related to critical thinking were the creation of new knowledge, developing analytical skills, and not learning only by memory. Likewise, the items that associated with AOT were to respect others and their viewpoints, to be disposed to know and learn topics, to understand and accept opinions, to investigate and inquire, to be critical, self-critical, and reflective, and to a lesser extent, to be patient, to listen, to believe and to analyse other people's arguments. Likewise, significant correlation evidence has been found among the study's variables. The result of Barnett's sphericity test is the Chi square = 16013.72, $p = 0.0$, which, together with the KMO = 0.96 value, show the convenience of the principal component analysis method.

In Table 4, the model is explained with three variables: (1) personality traits (19 items), (2) critical thinking skills (7 items) and (3) AOT (5 items).

Table 4
Principal component analysis

Rotated component matrix	Component		
	1	2	3
1. Honesty	0.768		
2. Empathy	0.765		
3. Solidarity	0.755		
4. Tolerance	0.735		
5. Equality	0.72		
6. Affectivity	0.715		
7. Inclusion	0.707		
8. Justice	0.674		
9. Being balanced	0.668		
10. Demanding respect	0.656		
11. Enthusiasm	0.63		
12. Having self-control	0.623		
13. Developing positive self-esteem	0.59		
14. Being capable of setting limits	0.575		
15. Responsibility	0.571		
16. Having self-confidence	0.563		
17. Being impartial	0.553		
18. Being autonomous	0.493		
19. Self-demand	0.473		
20. Creating new knowledge		0.763	
21. Developing analytical skills		0.718	
22. Not learning only by heart		0.706	
23. Managing to understand the subject's contents		0.686	
24. Researching the subjects' contents outside the classroom		0.679	
25. Relating the subjects' contents with what happens in real life		0.676	
26. Developing the ability to explain ideas clearly		0.642	
27. Knowing and learning the subject's contents and accepting opinions			0.636
28. Being critical, self-critical, and reflective			0.604
29. To be researched/investigated			0.636
30. Patience: listening, believing, and analysing the arguments of others.			0.538
31. Respect for others, respect for others' points of view			0.704

Extraction method: Principal Component Analysis. Rotation method: Varimax with Kaiser Normalization. The rotation has converged in 3 interactions.

In order to complement the EFA, a Confirmatory Factor Analysis (CFA) was carried out, to confirm the fit of the model obtained in the FEA, and the following values were obtained: NFI = 0.82, RFI = 0.8, CFI = 0.85, and RMSEA = 0.08.

AOT Predictor Variables

From the 31 items associated with three variables (personality traits, critical thinking skills and AOT), a linear regression analysis was performed to determine how these components affect the AOT criterion variable. To this purpose, and in order to determine whether or not the observable distribution of the ordinal categorical variable adjusts to a uniform distribution, the Chi-square test was previously performed.

The Chi-square = 319.98, $p = 0.00$ value affirmed that AOT variable does not adjust to a uniform distribution. Its ordinal behaviour allows for representing the centralization and dispersion parameters (median = 4, mode = 5, $P_{25} = 3$ y $P_{75} = 5$). The results of the distribution of frequencies obtained are added to these measures (Table 5).

Table 5

Distribution of frequencies of the criterion variable actively open-minded thinking

Response categories	Frequency	Valid percentage
Never	26	3.0
Rarely	72	8.2
Sometimes	224	25.6
Almost always	267	30.5
Always	286	32.7
TOTAL	875	100.0
Missed	2	
n	877	

Multiple linear regression analysis revealed the total contribution of the independent variables (personality traits and critical thinking), after the EFA, to the predictive level of the dependent variable “actively open-minded thinking”. The equation from the regression model obtained indicates that both variables contribute to explain 41% of the variability of the variable AOT ($R^2 = 0.408$, $F = 299.437$, $p = 0.00$). However, the variable which contributes the most to the explanation of the criterion variance is “personality traits” ($\beta = 0.57$, $p = 0.00$), while the variable “critical thinking skills” has a minor influence ($\beta = 0.104$ and $p = 0.00$). As it can be observed, both values are positive, therefore the higher the “personality traits” and “critical thinking skills” component value is, the higher the AOT values obtained (Table 6).

Table 6

Summary of the regression analysis

Principal Components	B	Beta	t
Personality traits	0.606	0.568**	21.779
Critical thinking skills	0.313	0.294**	11.274

** $p < 0.01$

For a correct interpretation of multiple linear regression, the independence case is confirmed by means of the Durbin Watson value = 1.96 (independent residues), as well as the normality of the independent factors. For its part, Pearson's r correlational analysis shows that the personality traits most influential in AOT are honesty ($r = 0.529$,

$p = 0.00$), empathy ($r = 0.466$, $p = 0.00$), solidarity ($r = 0.472$, $p = 0.00$) and tolerance ($r = 0.479$, $p = 0.00$) (Table 7).

Table 7
Summary of the most significant variables

Correlations	Honesty	Empathy	Solidarity	Tolerance
Open-mindedness (of ideas, open to dialogue)	0.529**	0.466**	0.472**	0.479**

** The correlation is significant at the level 0.01 (bilateral)

Analysis AOT as Related to Socio-Demographic Variables

Finally, the dependent variable (AOT) is described according to the social demographic variables “educational stage/level”, “sex”, and “type of educational centre”. Based on the normality criteria of these variables, and through nonparametric contrast (Kruskal-Wallis test), it was resolved that there are not any significant differences in the median tests. Thus, it can be confirmed that AOT is not different depending on the education stage (Kruskal-Wallis H test = 2.725, $p = 0.256$) (Table 8).

Table 8
Descriptive statistics of the “actively open-minded thinking” variable according to the educational level

Educational stage or level	Mean	Median	P ₂₅	P ₇₅
1 st Compulsory secondary education	3.92	4	3	5
2 nd Compulsory secondary education	3.82	4	3	5
3 rd Compulsory secondary education	3.77	4	3	5
TOTAL	3.82	4	3	5

In regard to the analysis of AOT based on the participants’ gender, it can be resolved that there are not any significant differences (Mann-Whitney U test = 83004.5, $p = 0.478$) (Table 9).

Table 9
Descriptive statistics of the “actively open-minded thinking” variable according to sex

Sex	Mean	Median	P ₂₅	P ₇₅
Female	3.85	4.00	3	5
Male	3.76	4.00	3	5
TOTAL	3.82	4.00	3	5

In the same way, when analysing AOT according to the “type of educational centre”, no significant differences have been found in the medians given to AOT depending on such a socio-demographic variable (Kruskal-Wallis H test = 0.438, $p = 0.803$) (Table 10).

Table 10

Descriptive statistics of the “actively open-minded thinking” variable according to the type of educational centre

Type of educational centre	Mean	Median	P ₂₅	P ₇₅
Public	3.80	4.00	3	5
Private	3.76	4.00	3	5
State-funded private	3.87	4.00	3	5
TOTAL	3.82	4.00	3	5

DISCUSSION

The study’s purpose was to analyse the relationship between AOT, personality, and critical thinking skills in secondary education students, and to determine the predictive ability of the variables of personality traits and critical thinking skills in relation to AOT.

AOT and critical thinking skills are necessary for individuals to be successful in their personal, social, academic and professional aspects of life. However, Hogan et al. (2015), Parrott and Rubinstein (2015) and Maynes (2017) added that critical thinking is more important than AOT, as it enables the development of metacognitive skills and epistemological evaluation. Differing from this approach, our study reveals that AOT is the driving force behind the critical thinking competence chain. This position is in line with a recent study by Kurniati et al. (2019), who argued that AOT behaviours are predictors of critical thinking.

The results of this research show, firstly, that AOT is related positively to both critical thinking skills and personality traits. However, the main finding of this study is that the *personal traits* component is closely linked to the AOT concept created by Baron (1991, 1994), and which is key for developing intelligence and psycho-emotional, social, and professional skills (Hypothesis 1). This is demonstrated by the value of the coefficient of determination (0.408), which indicates that there is a 41% of variance for the dependent variable explained by personality traits and critical thinking skills (Table 6).

Secondly, there is sufficient evidence to interpret that both variables (personality and critical thinking) are significant and predictive of the variable of AOT (Hypothesis 2). However, from them, AOT obtains a better correlation with personality traits, specifically with honesty, empathy, solidarity, tolerance, equality, affectivity, and inclusion. These findings are original, as no such relationships have previously been found. Some authors, such as Siavoshifar (2015), have proved that metacognition and personality are predictors of critical thinking but not of AOT. On this basis, it is possible to deduce that people who have AOT are able to elaborate new information in a richer and more objective way than those who have more rigid and closed mental structures (Heijltjes et al., 2015; Mellers et al., 2015; Svedholm-Häkkinen & Lindeman, 2018). Closed-minded cognitive thinking tends to filter and assess information in a biased way by confirming or consolidating pre-established opinions or beliefs. In this sense, a lack

of empathy, honesty, solidarity, tolerance, equality or affectivity could also cause biased cognitive thinking (Rigney, 2019).

Finally, when AOT is examined according to educational stage, gender, or type of educational centre, it is found that it does not differ. Thus, the individual, academic, and social benefits provided by AOT (Baron, 1991, 1994) suggest that it should be promoted as a mainstream skill at all educational stages.

Ulger (2018) argued that higher thinking has two components: critical thinking and creative thinking. With regard to the first component, in our study, the capacity for analysis, non-memorized learning and, less so, understanding and researching the contents of the subject outside the classroom (self-learning) especially stand out, while among the skills related to creative thinking, the creation of new knowledge prevails and the ability to establish relationships and to express ideas clearly are less present.

In these postmodern times, when the development of cognitive skills is given prominence, there is very little or no awareness that AOT, objective, balanced, fair, and contrasted thinking, is necessary for secondary education students' personal and intellectual development. It is therefore necessary to reconsider the true sense of education, bearing in mind the ethical and moral responsibility of AOT training (Siegel, 2017). Students' comprehensive training does not mean only learning the contents of a subject, but implies the *right* to think, question, disagree, doubt, prepare for adult and family life, learn to be honest, empathic, solidary, and tolerant, facilitating their participation as members of a research community, and integrating them into the democratic life of society in an active and conscious way. Training those qualities, which have been named "soft skills", shapes the individuals' mental and emotional mapping and will leave a mark on their future which will be decisive for the rest of their lives (Tang, 2018).

In accordance with As'ari et al. (2019), and Gürçay-Morris (2016), the classroom is the ideal framework for training critical thinking, in a context where students may be able to combine different views, thoughts, and ideas. Therefore, it is necessary to naturalize the classroom as a context where debate and student participation are promoted. Controversy creates discomfort, but challenges students and teachers' beliefs and values, and reveals ambiguities, questionable reasoning, and unfinished or missing information, which is being ignored and may be essential in order to solve a problem or reach an objective. In this sense, teaching students to be aware that their beliefs might not be perfect and may make them uncomfortable, but offers them a solid base to promote their critical thinking.

CONCLUSION

Based on the findings of this study, it is concluded that while it is essential to promote aptitudes, abilities, and metacognitive skills in students, it is more important to promote AOT because it is the ability that allows for the development of feelings, knowledge, and understanding of others; in sum, it is the transversal competence which intersects and covers all critical thinking skills. AOT allows a person to challenge, position and reflect on and/or weigh new evidence before making decisions or reaching final

conclusions (Svedholm-Häkkinen & Lindeman, 2018) Without it, critical thinking would not be able to reach the highest quality. Applying the neurological interaction metaphor, AOT would be the synapse or the nerve, chemical or electric impulse which allows for the development of critical thinking skills. Hence, the more that AOT is developed, the higher the projection and added value the critical thinking skills will have, both affectively and cognitively.

The arguments exposed lead us to insist and recommend that AOT is explicitly taught and learned in educational curriculum since learning to think well cannot be automatically learned by studying certain subjects. The importance of developing AOT in the classroom in a direct way, which is defended in this study, agrees with Stanovich and West (1997), who state that critical and creative thinking starts with AOT and that, in order to become “good thinkers”, it is necessary not only to listen to the other party but also to listen to arguments which oppose our established beliefs. Critical thinking needs to gather information with accuracy and concern, which is not an immediate act as it requires systematic training and learning. Consequently, it is suggested that AOT teaching and learning be explicitly integrated into the educational curricula, and especially in the first cycles of the education system.

In order to advance in this research field, it would be useful to study AOT’s relations with other variables regarding school coexistence, such as disruptive behaviours, gender-based violence, bullying, conflicts and aggressions in the school context (Price et al., 2015). It would also be interesting to analyse AOT’s correlation with adolescents’ dogmatic thinking as this is one of the factors responsible for violence and inequality in postmodern societies, which should be prevented in formal education. Finally, the third research line would be to analyse the way family members relate to one another, the way they deal with disagreements, and how the basic emotional aspects of listening, comprehension, and care influence AOT.

LIMITATIONS

Despite the results achieved, the study has limitations. The main limitation is that the conclusions are not generalizable because the sample is limited to the Spanish context. Therefore, it would be interesting to carry out a European cross-cultural study with students of the same educational stage. Likewise, the analysis of factors external to each person was not taken into account in order to better understand how AOT and critical thinking develop. Future studies should investigate the influence of mass media and ICTs, as well as the family, because these elements have a decisive influence on adolescents.

REFERENCES

Albertos, D., & De la Herrán, A. (2018). Desarrollo del pensamiento crítico en estudiantes de Educación Secundaria: Diseño, aplicación y evaluación de un programa educativo. *Profesorado. Revista de Currículum y Formación del Profesorado*, 22(4), 269-285. <https://doi.org/10.30827/profesorado.v22i4.8416>

- Allport, G. W., & Odbert, H. (1936). Trait-Names: A psycho-lexical study. *Psychological Review Monographs*, 47(1, Whole N° 211).
- As' ari, A. R., Kurniati, D., Abdullah, A. H., Muksar, M., & Sudirman, S. (2019). Impact of infusing truth-seeking and open-minded behaviors on mathematical problem-solving. *Journal for the Education of Gifted Young Scientists*, 7(4), 1019-1036. <https://doi.org/10.17478/jegys.606031>
- Barhaghtalab, E. Y., & Sharafi, M. (2016). The relationship between personality traits and critical thinking among female administrative officers in four districts and department of education in Shiraz. *Research Journal of Pharmaceutical Biological and Chemical Sciences*, 7(1), 790-795. <http://eprints.hums.ac.ir/4153/>
- Baron, J. (1991). Beliefs about thinking. In J. F. Voss, D. N. Perkins, & J. W. Segal (Eds.), *Informal reasoning and education* (pp. 169-186). Erlbaum.
- Baron, J. (1994). *Thinking and deciding* (2nd ed.). Cambridge University Press.
- Baron, J. (2019). Actively open-minded thinking in politics. *Cognition*, 188, 8-18. <https://doi.org/10.1016/j.cognition.2018.10.004>
- Bar-Tal, D., Vered, S., & Fuxman, S. (2020). Between open-minded critical thinking and closed-minded allegiance: Educational tensions in societies involved in intractable conflict. *Advance in Political Psychology*, 1-26. <https://doi.org/10.1111/pops.12687>
- Basri, H. (2019). Investigating Critical thinking skill of junior high school in solving mathematical problem. *International Journal of Instruction*, 12(3), 745-758. <https://doi.org/10.29333/iji.2019.12345a>
- Bastante-Ceca, M. J., Fuentes-Bargues, J. L., Mihai, F. C., Iatu, C., & Hufnagel, L. (2020). Introductory chapter: The need to change the paradigm-sustainability and development at the 21st century. In M. J. Bastante-Ceca (Ed.), *Sustainability Assessment at the 21st Century* (pp. 1-6). IntechOpen.
- Burbules, N. C. (2016). Being critical about being critical. *Democracy & Education*, 24(2), 1-5. <https://url2.cl/erPJd>
- Cattell, R. B., Schroder, G., & Wagner, A. (1969). Verification of the structure of the 16 PF questionnaire in German. *Psychologische Forschung*, 32, 369-386.
- Cattell, R. B., Wagner, A., & Cattell, M. D. (1979). Adolescent personality structure in Q-data, checked in the High School Personality Questionnaire. *British Journal of Psychology*, 61, 39-54.
- Changwong, K., Sukkamart, A., & Sisan, B. (2018). Critical thinking skill development: Analysis of a new learning management model for Thai high schools. *Journal of International Studies*, 11(2), 37-48. <https://doi.org/10.14254/2071-8330.2018/11-2/3>

- Cloete, M. (2018). The impact of an integrated assessment on the critical thinking skills of first-year university students. *Accounting Education*, 27(5), 479-494. <https://doi.org/10.1080/09639284.2018.1501717>
- Cotta, T. R., Gottschalg, C., Mori, A., de Andrade, M. T., & Orlandi, L. (2018). Gamification: a new multimodal approach to education. *Biblios*, (70), 17-30. <https://doi.org/10.5195/biblios.2018.447>
- Crocetti, E. (2018). Identity dynamics in adolescence: Processes, antecedents, and consequences. *European Journal of Developmental Psychology*, 15(1), 11-23. <https://doi.org/10.1080/17405629.2017.1405578>
- Ennis, R. (2011). *The nature of critical thinking: An outline of critical thinking dispositions and abilities* [Paper presentation]. Sixth International Conference on Thinking at MIT, Cambridge, UK.
- Ennis, R. (2015). Critical thinking: A streamlined conception. In M. Davis, & R. Barnett (Eds.), *The Palgrave handbook of critical thinking in Higher Education* (pp. 31-47). MacMillan.
- Facione, P. (1990). *Critical thinking: a statement of expert consensus for purposes of educational assessment and instruction*. American Philosophical Association, The California Academic Press.
- Facione, P., & Facione, N. (1992). *The California Critical Thinking Disposition Inventory Test Manual*. Millbrae, CA.
- Gürçay-Morris, B. (2016). *The use of alternative reasons in probabilistic judgment* [Doctoral Dissertation]. Department of Psychology, University of Pennsylvania.
- Heijltjes, A., van Gog, T., Leppink, J., & Paas, F. (2015). Unraveling the effects of critical thinking instructions, practice, and self-explanation on students' reasoning performance. *Instructional Science. An International Journal of the Learning Sciences*, 43, 487-506. <https://doi.org/10.1007/s11251-015-9347-8>
- Hogan, M., Dwyer, C., Harney, O., Noone, C., & Conway, R. (2015). Metacognitive skill development and applied systems science: A framework of metacognitive skills, self-regulatory functions and real-world applications. In A. Peña-Ayala (Ed.), *Metacognition: Fundamentals, applications, and trends A profile of the current state-of-the-art* (pp. 75-105). Springer.
- Janssen, E. M., Verkoeijen, P. J. L., Heijltjes, A. E. G., Mainhard, T., Peppen, L. M. V., & van Gog, T. (2020). Psychometric properties of the Actively Open-minded Thinking Scale. *Thinking Skills and Creativity*, 36(2020), 100659. <https://doi.org/10.1016/j.tsc.2020.100659>
- Kurniati, D., Purwanto, P., As'ari, A., Dwiwana, Subanji, & Susanto, H. (2019). Development and validity of problems with contradictory information and no specified

universal set to measure the truth-seeking of pre-service mathematics teachers. *TEM Journal*, 8(2), 545-553. <https://doi.org/10.18421/TEM82-30>

Kwong, J. M. (2016). Open-mindedness as engagement. *The Southern Journal of Philosophy*, 54(1), 70-86. <https://doi.org/10.1111/sjp.12163>

Ley Orgánica 3/2020, de 29 de diciembre, por la que se modifica la Ley Orgánica 2/2006, de 3 de mayo (LOMLOE), de Educación. *Boletín Oficial del Estado*, 340, 30 de diciembre de 2020. Ref. BOE-A-2020-17264. <https://bit.ly/3C3RHub>

Mahanal, S., Zubaidah, S., Sumiati, I. D., Sari, T. M., & Ismirawati, N. (2019). RICOSRE: A learning model to develop critical thinking skills for students with different academic abilities. *International Journal of Instruction*, 12(2), 417-434. <https://doi.org/10.29333/iji.2019.12227a>

Maynes, H. (2017). Steering into the skid: On the norms of critical thinking. *Informal Logic*, 37 (2), 114-128. <http://doi.org/http://dx.doi.org/10.22329/il.v37i2.4818>

Mellers, B., Stone, E., Atanasov, P., Rohrbaugh N., & Metz, S. E. (2015). The psychology of intelligence analysis: drivers of prediction accuracy in world politics. *Journal of Experimental Psychology: Applied*, 21(1), 1-14. <http://dx.doi.org/10.1037%2Fexp0000040>

Metz, S. E., Baelen, R. N., & Yu, A. (2020). Actively open-minded thinking in American adolescents. *Review of Education*, 8(3), 768-799. <https://doi.org/10.1002/rev3.3232>

Miftahul, N., Zubaidah, S., Mahana, S., & Suarsini, E. (2017). Improving junior high schools' critical thinking skills based on test three different models of learning. *International Journal of Instruction*, 10(1), 101-116. http://www.e-iji.net/dosyalar/iji_2017_1_7.pdf

O'Connor, K. (2020). Constructivism, curriculum and the knowledge question: tensions and challenges for higher education. *Studies in Higher Education*, 1-11. <https://doi.org/10.1080/03075079.2020.1750585>

Organisation for Economic Cooperation and Development. (2018). *PISA 2015: Results in focus*. <https://www.oecd.org/>.

Orluwene, G. W., & Okoye, O. J. (2020). Personality traits as predictor of critical thinking ability among undergraduate students of university of port harcourt. *EPRA International Journal of Multidisciplinary Research (IJMR)*, 6(4), 174-186. <https://doi.org/10.36713/epra2013>

Parrott, J., & Rubinstein, M. (2015). Metacognition and evidence analysis instruction: an educational framework and practical experience. *Systematic Reviews*, (4), 1-8. <http://doi.org/10.1186/s13643-015-0101-8>

Pretorius, L., van Mourik, G. P., & Barratt, C. (2017). Student choice and higher-order thinking: Using a novel flexible assessment regime combined with critical thinking activities to encourage the development of higher order thinking. *International Journal of Teaching and Learning in Higher Education*, 29(2), 389-401.

Price, E., Ottati, V., Wilson, C., & Kim, S. (2015). Open-minded cognition. *Personality and Social Psychology Bulletin*, 41(11), 1488-1504. <https://doi.org/10.1177/0146167215600528pspb.sagepub.com>

Rigney, A. E. (2019). *The role of biased searching through memory in motivated social evaluation* [Doctoral Dissertation]. The University of Texas at Austin.

Roa, J., Sánchez, A., & Sánchez, N. (2021). Evaluación de la implantación de la gamificación como metodología activa en la Educación Secundaria española. *Reidocrea*, 10(12), 1-9.

Rosidin, U., Kadaritna, N., & Hasnunidah, N. (2019). Can argument-driven inquiry models have impact on critical thinking skills for students with different personality types? *Cakrawala Pendidikan*, 38(3), 511-526. <http://doi.org/10.21831/cp.v38i3.24725>

Shaw, A., Liu, O. L., Gu, L., Kardonova, E., Chirikov, I., Li, G., Shangfeng H., Ningning, Y., Liping, M., Fei, G., Qi, S., Jinghuan, S., Henry, & Loyalka, P. (2020). Thinking critically about critical thinking: validating the Russian HEIghten® critical thinking assessment. *Studies in Higher Education*, 45(9), 1933-1948. <https://doi.org/10.1080/03075079.2019.1672640>

Sivavoshifar, N. (2015). Relationship between meta-cognition and personality characteristics in attitude toward critical thinking in students. *International Journal of Humanities and Cultural Studies*, 1(1), 213-228. <http://www.ijhcs.com/index.php/ijhcs/index>

Siegel, H. (2017). *Education's epistemology: Rationality, diversity, and critical thinking*. Oxford University Press.

Solimanifar, O., Behroozi, N., & Safaei, M. (2015). Role of personality traits, learning styles and metacognition in predicting critical thinking of undergraduate students. *Scientific Journal of Education Strategies in Medical Sciences*, 8(1), 59-67.

Standish, R., & Thoilliez, B. (2018). Critical thinking in crisis. A pedagogical reconsideration in three movements. *Teoría e Historia de la Educación*, 30(2), 7-22. <https://doi.org/10.14201/teoredu302722>

Stanovich, K. E., & West, R. F. (1997). Reasoning independently of prior belief and individual differences in actively open-minded thinking. *Journal of Educational Psychology*, 89(2), 342-357.

Stenhouse, N., Myers, T. A., Vraga, E. K., Kotcher, J. E., Beall, L., & Maibach, E. W. (2018). The potential role of actively open-minded thinking in preventing motivated

reasoning about controversial science. *Journal of Environmental Psychology*, 57, 17-24. <https://doi.org/10.1016/j.jenvp.2018.06.001>

Straková, Z., & Cimermanová, I. (2018). Critical thinking development-A necessary step in higher education transformation towards sustainability. *Sustainability*, 10(10), 1-18. <https://doi.org/10.3390/su10103366>

Sulistiana, S., Sriyono, S., & Nurhidayati, N. (2013). Pengaruh gender, gaya belajar, dan reinforcement guru terhadap prestasi belajar fisika siswa kelas XI SMA Negeri se-Kabupaten Purworejo Tahun Pelajaran 2012/2013. *Radiasi*, 3(2), 102-106.

Svedholm-Häkkinen, A. M., & Lindeman, M. (2018). Actively open-minded thinking: development of a shortened scale and disentangling attitudes towards knowledge and people. *Thinking & Reasoning*, 24(1), 21-40. <https://doi.org/10.1080/13546783.2017.1378723>

Takahashi, Y., Kusumi, T., & Manalo, E. (2016). Quasi-development of critical thinking attitude during adulthood, and links to the big five personality traits. *International Journal of Psychology*, 51(1), 901-901. <https://doi.org/10.1002/ijop.12337>

Tang, K. N. (2018). The importance of soft skills acquisition by teachers in higher education institutions. *Kasetsart Journal of Social Sciences*, 41, 22-27. <https://doi.org/10.1016/j.kjss.2018.01.002>

Teixes, F. (2015). *Gamificación, motivar jugando*. Universitat Oberta de Catalunya.

Ulger, K. (2018). The effect of problem-based learning on the creative thinking and critical thinking disposition of students in visual arts education. *Interdisciplinary Journal of Problem-Based Learning*, 12(1), 10, 1-21. <https://doi.org/10.7771/1541-5015.1649>

Van Aalderen-Smeets, S., & Walma van der Molen, J. (2013). Measuring primary teachers' attitudes toward teaching science: Development of the dimensions of attitude toward science (DAS) instrument. *International Journal of Science Education*, 35, 577-600. <http://doi.org/10.1080/09500693.2012.755576>

Villalustre L., & del Moral, E. (2015). Gamificación: Estrategia para optimizar el proceso de aprendizaje y la adquisición de competencias en contextos universitarios. *Digital Education Review*, 27, 13-31.

Vogt, W. (2007). *Quantitative research methods for professionals*. Pearson Education.

World Economic Forum. (2015). *New vision for education: Unlocking the potential of technology*. World Economic Forum.

Yue, M., Zhang, M., Zhang, C., & Jin, C. (2017). The effectiveness of concept mapping on development of critical thinking in nursing education: A systematic review and meta-analysis. *Nurse Education Today*, 52, 87-94. <https://doi.org/10.1016/j.nedt.2017.02.018>

Zelaieta, E., & Camino, I. (2018). El desarrollo del pensamiento crítico en la formación inicial del profesorado: análisis de una estrategia pedagógica desde la visión del alumnado. *Profesorado. Revista de Currículum y Formación del Profesorado*, 22(1), 197-214. <https://bit.ly/2FU5FE9>