

## Article

# Critical Thinking and Student Well-Being: An Approach in University Students

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**Abstract:** Human well-being is a dynamic and changing concept as it depends on personal, social, cultural, and political factors and varies over time according to individual circumstances. Therefore, it is essential to address this issue from a comprehensive and multidisciplinary approach, seeking that individuals, from an early age, manage to develop skills and attitudes that allow them to achieve a balance in their lives. This article presents the results of the measurement of students' perceived achievement of the competence of complex thinking in a subject focused on human development. Specifically, the research sought to identify whether there is a relationship between the level of critical thinking and the acquisition of skills associated with human well-being. The selection of critical thinking is based on the fact that this cognitive ability is one of the subcompetencies included in complex thinking. The sample was a group of university students from different disciplines and educational levels. Methodologically, descriptive analyses were made on the means of students' responses to a validated instrument measuring the perceived achievement of complex thinking competency and its subcompetencies and the final evaluations of the students' course. In conclusion, an improvement in the perception of achievement of complex thinking competency and its subcompetencies is demonstrated in the students, with critical thinking that achieved the best means, its increase being significant for the whole group and for women but not for men. In this sense, although it was not possible to demonstrate a statistically significant relationship between the development of this subcompetency and the acquisition of tools associated with well-being, data showing a possible association between these elements were obtained.

**Keywords:** higher education; educational innovation; complex thinking; critical thinking; human well-being



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## 1. Introduction

Human well-being is a broad and complex concept that refers to people's quality of life and integral development. It is understood as a state of satisfaction and balance in essential areas of life, such as health, safety, education, economy, interpersonal relationships, and social and political participation [1]. Human well-being is not limited to the absence of illness or problems but also encompasses the achievement of a sense of purpose and personal fulfillment, as well as access to opportunities and resources that enable people to reach their goals and potential.

Human well-being is a constantly evolving concept influenced by personal, social, cultural, and political factors, and it varies over time based on individual circumstances because it is deeply connected to the essence and actions of individuals [2]. The COVID-19 pandemic significantly impacted people's well-being, especially their health, social relationships, and emotional states [3]. The need for social distancing and the restriction of activities affected people's interactions, increasing the feeling of isolation and loneliness.

In turn, uncertainty and illness-related concerns increased stress and anxiety, ultimately impacting their mental health [4]. Identifying how young people cope with life events is of fundamental importance in terms of health, as one in two young people aged 18–29 are possibly subject to anxiety or depression, with a higher risk in young women, who are also estimated to be unable to return to school due to the need to sustain a livelihood [5]. Globally, the differences in access to online and distance higher education have highlighted the digital gap, evidencing the loss of learning associated with absenteeism, dropouts, and school closures.

Therefore, it is crucial to tackle human well-being using a holistic and interdisciplinary approach, aiming for individuals to acquire the skills and attitudes necessary for achieving life balance from a young age. Although universities have always had a commitment to human development and well-being, nowadays, it can be seen that these issues are taking a more relevant place within their agendas [6]. In this sense, all of us who are part of these institutions must have a commitment to well-being as this is a challenge that not only corresponds to the emotional counseling areas of the universities. Moreover, and retaking the holistic and interdisciplinary sense, human well-being is a subject that concerns anyone from any discipline, especially because human beings, as integrated entities, have different elements that make up their vision of well-being; therefore, every professional has a different point of view that can complement each other.

This article presents the results of measuring students' perceived achievement of complex thinking competency in a subject focused on developing human well-being skills. Specifically, we seek to identify whether there is a relationship between the level of perception of critical thinking and the acquisition of skills associated with well-being. The choice of critical thinking focuses on the relevance of this subcompetency at the moment of making decisions and becoming aware of one's own capabilities, highly relevant aspects in the process of well-being. This has already been argued by previous studies, such as those of Hoffman and Elwin [7], who link critical thinking to improved confidence in decision-making, as well as the study by Cohen, Freeman, and Thompson [8], who link critical thinking to tactical decision-making in the U.S. Navy.

Methodologically, descriptive analyses were made on the means of responses to a validated instrument measuring the perceived achievement of complex thinking competency and its subcompetencies and the final evaluations of the students' course. The selected course aims to enable students to acquire and develop emotional tools that are associated with well-being; therefore, their final evaluation is related to the level of reflection and analysis carried out during the semester and, therefore, their commitment to acquiring these skills.

### *1.1. Theoretical Framework*

#### *The Promotion of Human Wellness by Universities*

Human well-being is critical to university students' overall health and status. Mental health problems such as anxiety, depression, and stress are common among students and can negatively affect their academic performance, personal relationships, and overall human well-being [9]. It is important to note that these discomforts not only impact students, but emotional distress can be seen in other groups in the university community, such as faculties, researchers, or administrative staff [10].

Consequently, universities are recognizing the importance of addressing the issue by implementing different actions to improve the emotional states of their community and reduce factors that negatively impact the human well-being of individuals. Many universities offer emotional health services, such as counseling and therapy, for students in need, developing early intervention and care programs that, rather than addressing diagnosed psychopathologies, seek to implement emotional containment tools that improve the mental state of individuals [11]. In this sense, mental health awareness campaigns are also developed through educational programs and specific courses that help students understand the importance of their emotions and overall health. Some of these campaigns and

programs include online resources, such as apps and websites, which allow constant interaction with students, helping them to manage their mental health with related information, self-help tools, and access to professionals if necessary [12].

In addition to these actions, some institutions have undertaken measures to help themselves and their students by developing support groups that provide students with a safe and mutually supportive environment. In this way, universities encourage their community to participate in activities, courses, and educational interventions that promote health and human wellness, seeking to contribute to a healthier university environment [13].

Although many of these institutions have focused on emotional health issues, they ultimately seek the development of human wellness as, beyond emotions, they also develop physical, social and intellectual development programs. In conclusion, universities are taking a holistic approach to address the human well-being of their community, recognizing that it is a critical component of overall health as well as academic success. In this sense, and seeking to adhere to this integrated vision of well-being, this article is based on the development of the notion of human well-being.

### 1.2. Competencies and Skills Associated with Human Well-Being

An essential component of any educational initiative aimed at enhancing human well-being is not just concentrating on emotional support or crisis management but also striving to foster the growth of individuals' personal abilities and capabilities. In this sense, universities have paid special attention to some emotional elements that are decisive when talking about emotional health, such as emotional intelligence [14], resilience [15], positive thinking [16], mindfulness [17], self-care [18], and building social support networks [15], as well as acquiring communication skills [19].

It is recognized that there are many other tools associated with people's well-being and emotional health; however, the breadth of the notion of well-being itself leads to the fact that the associated competencies may differ according to the needs of the individuals themselves and their lifestyle [20]. In general, skills should be cultivated that enhance the overall sense of well-being as well as impact a better quality of life.

### 1.3. Complex Thinking and Its Impact on Human Well-Being

Complex thinking, as a competency, involves a series of cognitive processes and affective components that allow analyzing information and generating new ideas and perspectives [21]. This ability allows people to understand complex systems, establish connections between apparently different pieces of information, and solve problems comprehensively [22]. For Morin [23], complexity does not refer to a particular difficulty or conflict but rather to managing uncertainty and diverse sets of information in constructing an integrated conclusion.

At the formative level, this study is based on Morin's proposal, who considers that the competence of complex thinking comprises four subtypes of thinking that contribute to this vision of integrality: systemic thinking, critical thinking, scientific thinking, and creative or innovative thinking (Table 1).

**Table 1.** Subcompetencies of complex thinking.

Subcompetency	Characteristics
Systemic Thinking	As per Jaaron and Backhouse [24], systemic thinking is linked to the capacity for a comprehensive and integrated examination of issues. Consequently, it takes into account interdisciplinarity and transdisciplinarity, aiming to connect various aspects of reality. Therefore, systemic thinking establishes connections within the fabric of reality, recognizing the intricate nature of reality itself, which encompasses a multitude of diverse elements.
Critical Thinking	This form of thinking is viewed as a subsidiary skill that aids in assessing and ensuring the soundness of the reasoning that forms the basis for making logical judgments about a situation or problem. It involves the dismantling of prevailing frameworks concerning contemporary events, as outlined by Cui, Zhu, Qu, Tie, Wang, and Qu [25].

Table 1. Cont.

Subcompetency	Characteristics
Scientific Thinking	Scientific thinking, as a subordinate skill, relies on resolving issues within the framework and methodology established by accepted and standardized procedures in the scientific field to investigate and generate tangible evidence. Consequently, individuals tackle environmental questions and problems by amalgamating diverse cognitive processes, such as inductive and deductive reasoning, as well as the development and testing of hypotheses, among other techniques, as outlined by Suryansyah, Kastolani, and Somantri [26].
Innovative Thinking	This specific skill involves engaging in the cognitive processes of exploration, which aid in contextualizing and visualizing issues from various viewpoints and angles [27], ultimately leading to the generation of innovative and viable solutions.

Source: Own creation based on Vázquez-Parra, Carlos-Arroyo, and Cruz-Sandoval [28].

Regarding the relationship of this competency and its subcompetencies to human well-being, complex thinking fosters intellectual stimulation and a sense of fulfillment by allowing individuals to experience a sense of accomplishment as they understand and solve complex problems [27]. In addition, complex thinking can also lead to greater creativity as it generates new and innovative ideas and solutions [29]. Hence, gaining a deeper understanding of success in intricate cognitive thinking and its related skills enables individuals to identify themselves as having enhanced cognitive abilities, offering mental engagement by acknowledging their involvement in integrative interacting systems [30].

#### 1.4. Critical Thinking as a Relevant Cognitive Skill for Well-Being

Critical thinking is a fundamental cognitive skill that involves analyzing, evaluating and reflexively questioning information, ideas, and arguments before accepting or rejecting them [31]. One of the essential characteristics of critical thinking is the ability to think independently and objectively without being easily influenced by biases, emotions, or personal beliefs [32]. This ability promotes informed decision-making and effective problem-solving, allowing the identification and analysis of the validity and reliability of sources of information and, thus, the way in which reality is perceived [33].

Individuals who possess critical thinking can discern between true and false information, as well as objectively evaluate the stimuli around them beyond existing paradigms, which is crucial to build their own vision of the world [34]. Having developed critical thinking allows for a deeper and more complete understanding of oneself, the decisions one makes and the impact of one's actions [35]. In addition, critical thinking fosters the ability to argue in a coherent and persuasive manner, allowing people to build solid arguments, which, in turn, promotes social interaction and dialogue [36,37].

Specifically, critical thinking is essential in developing people's well-being, especially in uncertain realities because it enables them to understand complex issues by identifying their causes, allowing them to solve problems more effectively [38]. Faced with an uncertain world such as the postpandemic reality, people must adopt a flexible view of their environment, benefiting from any cognitive tool that helps them cope with the constantly changing world. In this sense, critical thinking can improve the decision-making process and lead to lower stress and anxiety in people as they are better prepared to evaluate information and make choices that impact their general or professional lives [39].

On a formative level, critical thinking also promotes intellectual growth and a sense of purpose, as individuals examining their beliefs about problems can explore new ideas and perspectives, developing reflection and introspection that leads to a greater understanding of oneself and one's place in the world [40]. In conclusion, it is theoretically possible to associate critical thinking with human well-being as it is considered a positive skill that contributes to reducing uncertainty and, thus, to more accurate, balanced, and positive states of mind [41].

Taking all of the aforementioned factors into account, it is theoretically possible to establish a potential connection between the advancement of complex thinking skills, partic-

ularly the subcomponent of critical thinking, and certain emotional aspects linked to human well-being, such as the development of tools for the management of stress, depression, or anxiety. However, it remains uncertain whether this association will be noticeable among university students. Furthermore, it raises questions about the practicality of assessing this correlation within a course that is designed to teach these emotional attributes.

## 2. Materials and Methods

### 2.1. Participants and Procedure

A sample of 51 students (Table 2) taking the human well-being course “Keys to Happiness for Human Flourishing” was composed at a technological university in the western region of Mexico. This course is part of the student wellness program offered by this institution, and its objective is to develop skills associated with human well-being and the acquisition of tools for emotional balance. The course “Keys to Happiness for Human Flourishing” is a 15-week course, in which students address topics associated with human well-being from an emotional, intellectual, cognitive, and social approach. In this sense, the participants of this course acquire tools associated with the control of stress, anxiety, and depression, as well as reflect on the importance of collaboration, social relationships, and living positive experiences. This is a subject that not only focuses on emotional aspects but also on elements associated with human well-being.

**Table 2.** Characteristics of the sample by gender.

Men		Women		Total	
<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
20	39%	31	61%	51	100

It is relevant to point out that the competency of complex thinking is considered by this institution as a transversal competency that must cross any discipline; therefore, as part of this course, the concrete development of the subcompetency of critical thinking is declared. For the purposes of this study, we have taken the proposal of Morin [23], which is the vision that the institution where the study was conducted has adopted for the deployment of the competency of complex thinking as a transversal cognitive skill [42].

The study was conducted during the August–December 2022 semester. All participating students were between the first and third semester of studies, which is the stage at which this course is offered. The implementation process was carried out by digitizing the instrument using Google Form, requesting that all participants respond during the first week of the course (pre application) and during the last week of the course (post application).

As this study was exploratory and involved human participants, its execution adhered to ethical standards and received regulatory approval from the interdisciplinary research team R4C (Reasoning for Complexity). Technical assistance for the study was provided by the Writing Lab at the Institute for the Future of Education at the Tecnológico de Monterrey. In order to respect the personal data of the participants, the ethics committee has regulated the information that can be shared in this study about the students.

Given the exploratory nature of the implementation, the research team recommended initially limiting the study population to a single group of students, but they were willing to expand the sample size for future studies if this exploratory analysis proved to be satisfactory, i.e., if a correlation between the variables proposed was demonstrated.

### 2.2. Instrument and Data Analysis

For this study, the validated E-Complexity instrument was applied. This tool is designed to assess participants’ perceived level of competence in complex reasoning and its associated subcompetencies. It is a thoroughly validated instrument, both theoretically and statistically, by a team of experts in the field [43].



The design of the instrument was based on the conceptualization of the complexity reasoning competency and its subcompetencies. Three criteria were considered for the evaluation: clarity, coherence, and relevance. For the clarity criterion, the mean of the experts' evaluation was 3.31, with 82.7% on a scale of 1 to 4. For coherence, the mean was 3.38 (84.5%), and for relevance, the mean was 3.54 (88.5%). Thus, the three criteria obtained a score of over 60%, which places them at a high level (3–4), allowing us to conclude that the instrument was valid for measuring what it sets out to do.

In terms of its structure, E-Complexity is made up of 25 statements that are re-weighted on a 5-level Likert scale, which ranges from 1. Its items are categorized according to the 4 subcompetencies that make up complex thinking: systematic thinking (items 1–6), scientific thinking (items 7–13), critical thinking (items 14–19), and innovative thinking (items 20–25) [43].

In addition to applying this instrument, we also considered the group's final grades, scored on a scale of 1–100 points. The intention of considering the group grades is because, being a subject that considers different deliverables and activities associated with the acquisition and development of emotional tools associated with human well-being, it is valued that those people with better evaluations also showed a better commitment to the course and its objectives. Although we recognize that we cannot measure the students' state of well-being, we can know their degree of commitment and interest in acquiring and developing emotional tools that contribute to their well-being. In this sense, this study seeks to determine this possible relationship.

Regarding data processing, a multivariate descriptive statistical analysis was carried out using SPSS (Statistical Package for the Social Sciences) version 21. The statistical analysis analyzed arithmetic means and standard deviations, employed bar charts, boxplots, and scatter plots for data visualization, and included significance tests. The means analysis intended to use the means as a reference value in the data set against a given variable. Complementarily, the standard deviation allowed us to know the dispersion of the values around the mean.

On the other hand, the boxplot analysis, also known as the box and whiskers diagram, allowed the visual identification and comparison of information from the data based on its location in quartiles (or percentiles). The boxplot shows four main characteristics of the data: its center, dispersion, skewness, and outliers for the competency and subcompetencies [44]. In addition, a scatter plot was produced to show the correlation between complex thinking and the development of welfare techniques or tools based on the participants' ratings. Finally, to determine whether there was statistical significance between the mean values of the critical thinking subcompetency between the pre and post implementations, we conducted a Student's *t*-test analysis, using a *p*-value of 0.05.

### 3. Results

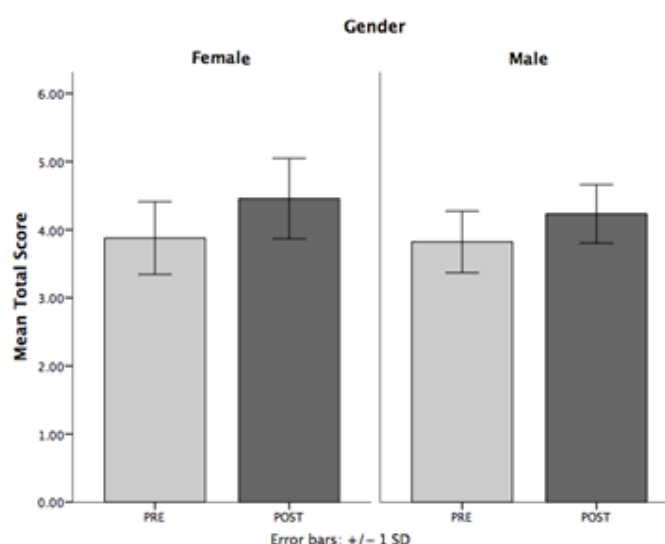
First, we wanted to acquaint what is the perceived achievement of the complex thinking competence of men and women at the end compared to the beginning of a well-being course. To respond to this question, the following results are presented for the performance of the complex thinking competency and its subcompetencies of critical, systemic, scientific, and innovative thinking. Table 3 shows the participants' means and standard deviations of the competency and subcompetencies, using the e-Complexity instrument, differentiating between men and women in each phase of this study (pre and post).

Figure 1 graphically shows only the complex thinking (overall competency) scores obtained in the e-Complexity, differentiated by men and women in this study's pre and post phases. Higher means were obtained in the complex thinking competency in the post phase compared to the pre phase for both men and women (a difference of 0.58 points for women and 0.41 points for men). Due to these results, our next question was: are the differences between the total complex thinking scores at the beginning and at the end of

the well-being course statistically significant? If so, will this finding be true for both men and women?

**Table 3.** Means and standard deviations of the e-Complexity responses in this study's pre and post phases.

	PRE Mean (Standard Deviation)					POST Mean (Standard Deviation)				
	Systemic Thinking	Scientific Thinking	Critical Thinking	Innovative Thinking	Complex Thinking	Systemic Thinking	Scientific Thinking	Critical Thinking	Innovative Thinking	Complex Thinking
Female	3.96 (0.50)	3.68 (0.72)	4.07 (0.53)	3.84 (0.71)	3.88 (0.53)	4.35 (0.53)	4.19 (0.70)	4.38 (0.52)	4.23 (0.69)	4.46 (0.59)
Male	3.93 (0.52)	3.59 (0.51)	4.03 (0.53)	3.78 (0.62)	3.82 (0.45)	4.02 (0.51)	3.97 (0.49)	4.27 (0.44)	4.06 (0.52)	4.23 (0.43)
Total	3.94 (0.50)	3.64 (0.64)	4.05 (0.52)	3.82 (0.67)	3.85 (0.50)	4.22 (0.55)	4.11 (0.63)	4.33 (0.49)	4.16 (0.63)	4.37 (0.54)

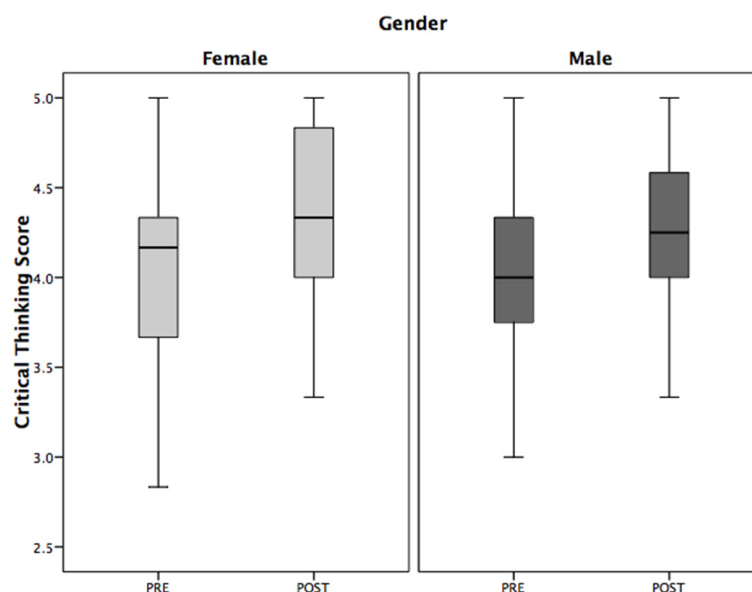


**Figure 1.** Average complex thinking scores obtained by men and women in the E-Complexity pre and post phases.

The *t*-test analysis showed that this difference was statistically significant for both females ( $t = -6.31$ ,  $gl(30)$ ,  $p = 0.000$ ) and males ( $t = -3.5$ ,  $gl(19)$ ,  $p = 0.002$ ).

Regarding critical thinking, Figure 2 graphically shows the scores obtained in the e-Complexity instrument. For both the pre and post phases of this study, higher values were attained by females (pre = 4.06 points,  $SD = 0.53$ ; post = 4.38 points,  $SD = 0.52$ ) compared to males (pre = 4.03 points,  $SD = 0.53$ ; post = 4.27 points,  $SD = 0.44$ ). Likewise, higher scores were observed in the post phase compared to the pre phase for males and females with differences of 0.24 and 0.31, respectively.

Based on the graphical results, our next question was: are the differences observed in critical thinking between the pre and post phases, both in men and women, statistically significant? To answer this question, a Student's *t*-test of related samples was performed for the total sample and each group. Among all participants, we found a significant difference in their performance in the critical thinking subcompetency between the pre and post phases ( $p = 0.000$ ). By gender, Table 4 shows that for women, the difference was statistically significant ( $p = 0.000$ ) but not for men ( $p = 0.90$ ).



**Figure 2.** Mean scores attained by men and women in the critical thinking subcompetency in the e-Complexity instrument, pre and post phases.

**Table 4.** Student's *t*-test values for participants' critical thinking subcompetency scores.

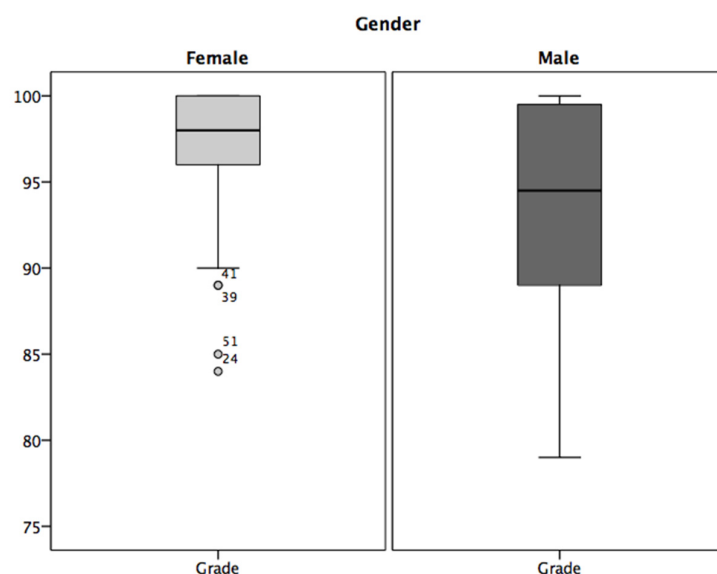
	Female ( <i>n</i> = 31)			Male ( <i>n</i> = 20)			All ( <i>n</i> = 51)		
	<i>t</i>	df	Sig (2-Tailed)	<i>t</i>	df	Sig (2-Tailed)	<i>t</i>	df	Sig (2-Tailed)
Pair Pre–Post	−4.51	30	0.000 *	−1.78	19	0.90	−4.24	50	0.000 *

\*  $p < 0.000$ .

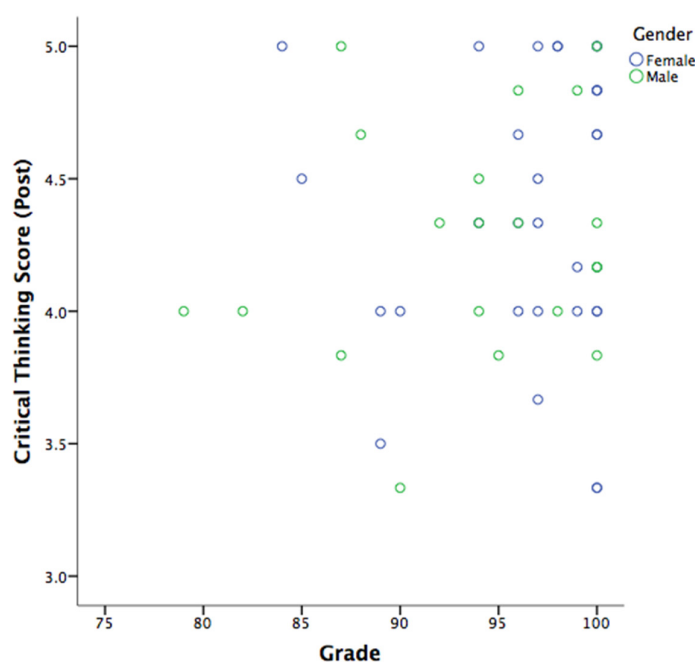
Finally, given that the participants in this study were enrolled in a well-being course, we asked: what was the academic performance of men and women enrolled in such a course? Is there any relationship between their performance in the well-being course in terms of numerical grade and their perceived critical thinking achievement? To answer these questions and respond to the main objective on the relationship between critical thinking and well-being, the numerical grades at the end of the course of the participants in this study were obtained. The grading scale was established from zero to one hundred points, with “100” being the maximum grade. Of the total sample, an average grade of 95.35 was obtained ( $SD = 5.43$ ). A higher score was attained by women (96.52,  $SD = 4.55$ ) than by men (93.55,  $SD = 6.27$ ). Figure 3 graphically shows the means differentiated by gender. In the women's group, some outliers were observed (circles in the figure). The numbers indicate the number of cases.

Next, Figure 4 shows the dispersion of the critical thinking score in the post phase as a function of the numerical scores obtained by the participants in this study. As can be seen, there is no trend of a linear relationship between the variables, which was confirmed with a Spearman correlation analysis that was not statistically significant ( $r = 0.116$ ,  $p = 0.41$ ). Despite this, a scatter plot is shown because the raw data are considered valuable to identify the performance of the participants according to their gender.





**Figure 3.** Average numerical grades obtained by men and women in the human well-being course, with outliers.



**Figure 4.** Scatter plot of the critical thinking scores in the post phase and the average numerical grade obtained in the subject taken by the participants in this study.

#### 4. Discussion

The first analysis examined the sample's means and standard deviations, separating the results by gender and pre and post implementation of the course. First, regarding the general competency of complex thinking, there was considerable improvement in the means between the two measuring moments, increasing from 3.85 to 4.37 (13.5%). By gender, women achieved the highest final mean (4.46) and the most improvement (14.9%). Men had a final mean of 4.23 and an improvement of 10.7%. This difference by gender can be corroborated by Figure 1, which shows that women, along with their higher means, had more standard deviation towards the top of the scale. Thus, as a first finding, it is possible to state that, although the course participants generally managed to improve their

perceived achievement of complex thinking competency, women are the ones who showed better results.

At the subcompetency level, innovative (or creative) thinking had the highest mean (4.37) and the most improvement (14.3%). Although systemic thinking and critical thinking showed high initial data, their improvement was slight compared to innovative thinking. For its part, scientific thinking had the lowest final mean (4.11) but an improvement of 12.9%.

By gender, these data did not follow the same pattern. For women, the subcompetency with the best final result was critical thinking (4.38), and scientific thinking showed the most improvement (13.8%). Similarly, men had the best final result in critical thinking (4.27) and the most improvement in scientific thinking (10.5%).

Thus, our second finding identifies critical thinking as the subcompetency with the best means for men and women and scientific thinking as the subcompetency with the most improvement. It is interesting to note that for neither women nor men, innovative thinking did not have the best final mean or improvement, as indicated by the combined mean; however, as the averages achieved by men were so low, the means of the other subcompetencies were affected when both groups were combined.

Notably, the course in which this study was conducted declares the intention to develop critical thinking in its curriculum because it is the subcompetency theoretically associated with developing well-being techniques. Figure 2 graphically explains the means and the improvement achieved in this subcompetency between men and women. As seen in the box plot graphs, although the initial means between the two groups are not so different (M-4.03, W-4.07), the final results differed; women improved by 7.6%, but men only increased their perceived mastery by 5.9%. Note that the standard deviation of both genders is very wide, and in both, outliers were found ranging from the lower to the upper parts of the scale. Even so, it is noticeable that the final values of the women's group presented a greater tendency towards positive results, reversing its initial trend. For men, the tendencies of the boxes are similar at the beginning and end of the measurement. The latter situation made it necessary to perform an analysis to evaluate whether the means attained between the initial and final measurements showed numerical differences that were statistically significant. Table 4 shows that although in the overall sample, the critical thinking subcompetency did show a statistically significant improvement, it was due to the women. In the case of men, although there was an improvement, it was not statistically significant.

To better understand these results, we considered the possibility of other elements influencing this difference between men and women in their perceived achievement of the critical thinking subcompetency. We analyzed the participants' ratings, evaluating whether there was a relationship between critical thinking and the development of well-being, considering that the score of their assignments shows their level of commitment and interest in developing emotional skills associated with their well-being. Thus, Figure 3 presents the grades analysis considering men's and women's means.

In general, women not only achieved the group's best mean and standard deviation, reaching the top of the grading scale but reversed some atypical cases of students who poorly perceived themselves (outliers). Conversely, while men demonstrated satisfactory performance, their average score was lower than that of their female counterparts, and this difference is evident in their data distribution, which did not reach the higher levels seen in women. Moreover, the standard deviation for males exceeded that of females.

Generally, it is possible to note a relationship between the high scores and the high level of perceived achievement of the critical thinking subcompetency, which can be understood due to the concentration of responses in the upper right part of the graph. However, a correlation test determined this is not statistically significant because of the outliers that disperse the result. Even so, although the correlation was not statistically proven, it is possible to note a propensity between good grades and the best-perceived level of critical thinking.

In conclusion, from these results, it is possible to point out the following findings:

1. The participants of the studied course improved their perceived achievement of complex thinking competency and all its subcompetencies. This is in accordance with previous studies such as those conducted by Cruz-Sandoval, Vázquez-Parra, and Amézquita-Zamora [21], who found that there is a natural development of the complex thinking competence in students, although in their study, they do not specify a specific course;
2. Although the critical thinking subcompetency did not improve the most, it did have the highest means in both the women's and men's groups. The best improvement occurred in the scientific thinking subcompetency. This is consistent with that identified by Cruz-Sandoval et al. [45], who applied a similar study in a group of engineering students and found a similar trend in which, although scientific thinking was not the subcompetency with the highest mean, it was the one that showed the highest development within a formative process;
3. Despite the numerical improvement, the men's improvement in the critical thinking subcompetency from the beginning to the end of the course was not statistically significant, but the female improvement was. This tendency to show a better perception on the part of women had also already been identified by Vázquez-Parra et al. [27] who applied EComplexity to a group of higher education students and found that women not only showed the best averages but also showed the most favorable development;
4. Regarding final grades, females had the highest mean;
5. Although a slight correlation can be seen between the perceived achievement of the critical thinking subcompetency and the participants' grades, this relationship cannot be proven statistically significant, remaining only as a possible association. In this sense, it is not possible to argue that the level of engagement and analysis performed in their class assignments could be directly influenced by their level of critical thinking.

Despite the specific results of this study, it is feasible to identify that most of the trends identified are in line with other studies previously conducted, which provides some reliability to this implementation.

#### *Academic Limitations and Implications*

Thus, it is possible to point out that the objective of this article has only been partially fulfilled, as the results show that the correlation between critical thinking and well-being is not statistically significant. Even so, this does not imply that the results are not valuable, especially because something that could be demonstrated is that critical thinking is the subcompetency that yielded the best final results. Thus, it is recognized that this study should be considered only as an exploratory approach to the subject and that its findings are not conclusive or definitive.

It is recognized that this work was limited by the small sample size and only considering the students' grades and no other student characteristics; however, we believe that the results allow us to propose defined lines of research for the future of this study, which, as indicated in the methodology section, was only approved by the university's supervising research group on an experimental basis. Additionally, we believe that the level of analysis achieved, being only quantitative, can be perceived as limited, as it focuses on identifying and not on describing the students' perception. In this sense, we believe that it would be very valuable to expand the methodology for future research in which, through qualitative analysis, we can understand these results in greater depth.

Despite these limitations, future lines of work remain open as these results contribute, albeit in a limited way, to the theoretical study of complex thinking and its subcompetencies, inviting the need for further studies that relate this competence to the development of people's well-being. Additionally, these results can be valuable in a practical way, especially for those universities concerned about the emotional health of their students who want to implement pedagogical tools that contribute to well-being along with curricular training.

## 5. Conclusions

The search for well-being and developing competencies such as complex thinking or critical thinking are related elements despite seeming different. Well-being involves individuals' subjective assessment of their happiness and satisfaction, which can influence the way they perceive their reality. In this sense, critical thinking provides people with skills to analyze, evaluate and synthesize information, and construct reasoned judgments of their environment and themselves.

Considering this, the present study had the objective of seeking quantitative arguments to identify the possible relationship between the development of critical thinking and the acquisition of emotional skills associated with well-being in a group of students of a course that declares both intentions. Overall, this study did show that the perceived achievement of critical thinking competency improved in the group in general, achieving significant levels in both males and females. However, it failed to show a statistically significant relationship between this improvement and the final course grades. Although a possible association between these elements is indicated, it is essential to note that this relationship could be complex and multifaceted, involving other factors, such as social support, personal values, and cultural norms, not considered in this study. However, the study's results are valuable for shedding light on the possible relationship and its implications.

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