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UNIVERSITÀ DI PAVIA

ISYDE2024

Italian Symposium on
DIGITAL EDUCATION

University of Pavia 19 - 21 June 2024

Lifelong Digital Learning and Education: promoting flexibility, inclusion, critical thinking and international exchange

Annamaria DE SANTIS, Elena CALDIROLA e Pietro CARRETTA

Conference PROCEEDINGS

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Preface

ISYDE 2024, the *Italian SYmposium on Digital Education,* has been jointly organized by the *Italian e-Learning Society* (SIe-L, https://www.sie-l.it/) and *Italian Society for Media Education Research* (SIREM, https://sirem.org/).

The 2024 edition focused on "Lifelong Digital Learning and Education: promoting flexibility, inclusion, critical thinking and international exchange" and aimed to promote innovative teaching and learning experiences enabled by technologies in the national and international scenario, able to transform educational paths into flexible and inclusive ecosystems.

Good teaching practices are the starting point for removing barriers and promoting inclusion, intercultural, and international exchange; favoring wellbeing and professional upskilling and reskilling throughout life through education and appropriate communication strategies; critically analyzing digital messages and environments.

The conference, which serves as a meeting point for sharing research, experiences, and technological applications, was held at the University of Pavia (Italy) from June 19 to 21, 2024.

Nearly 200 participants presented more than 60 contributions merged into eight Sections in the proceedings:

- Blended and Distance Learning (8)
- Teaching innovations, Communicating Science and emerging technologies in Education (10)
- Digital UpSkill and ReSkill for Adult Learners, Career Development and Training (5)
- Experiences in Education (11)
- Digital Citizenship and Media Literacy (4)
- Diversity, Equity, and Inclusion (6)
- AI in Education (13)
- Collaboration Projects and Networks (5).

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Reality vs. perception: exploring the Dunning-Kruger Effect on literacy and numeracy skills in university students

Claudia BELLINI, Annamaria DE SANTIS,
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University of Modena and Reggio Emilia, (ITALY)

Abstract

The present research aims to explore the Dunning-Kruger (DKE) effect on literacy and numeracy skills among university students just enrolled in the first year of the Digital Education degree course at the University of Modena and Reggio Emilia (a.y. 2023/2024).
Also called by the authors "unskilled and unaware", the DKE shows that incompetent individuals have more difficulty recognizing their true level of ability than more competent individuals, generating estimation errors in performance by both.
We explore these effects in our study, investigating a sample of students who assessed their ability in literacy and numeracy skills, according to ISFOL definition (2014), through an incoming skills assessment tests on basic knowledge to verify that there are no significant deficiencies in particular disciplines. In line with DKE, it has been hypothesized that students with lower performance may show a tendency to overestimate their abilities, while those with higher performance may have a more accurate perception of their skills.
Statistical methods of analysis processed the results of a questionnaire on Metacognition Awareness (MAI) and put in relation literacy and numeracy tests results to the student's perception of performance, expressed through a range of choice from -10 to 30 (literacy test) and 10 e 30 (numeracy test).
The results of this research aim to contribute to the lack of research studies on the impact of the Dunning-Kruger effect on literacy and numeracy skills, besides having important implications for the educational practice and skill development of university students.

Keywords: Dunning-Kruger Effect, University Students, Literacy, Numeracy, Skills.

1. Introduction

The Dunning-Kruger Effect (DKE) is a cognitive bias that describes the tendency of less competent individuals to overestimate their abilities while more competent individuals more accurately assess their performance (Kruger & Dunning, 2009).

The study demonstrates that individuals with lower abilities in specific areas tend to overestimate their performance and skills. This cognitive bias occurs because these individuals lack the metacognitive ability to assess their limitations, leading to inflated self-assessments. To demonstrate, the authors conducted four experiments across domains, including humor recognition, logical reasoning, and grammar, assuming that incompetent individuals overestimate their abilities because they lack the self-awareness or the necessary metacognitive skills to recognize their deficiencies. In each study, participants in the lowest quartile of performance greatly overestimated their competence. Conversely, participants with higher competence were more accurate in their self-assessments, though they sometimes underestimated their abilities relative to others. In one of the four experiments, after training to improve their logical reasoning, low-performing participants were better able to assess their competence and reduced their overestimated abilities. This supports the idea that competence and self-awareness are linked.

This phenomenon is widely recognized in cognitive psychology and has implications for various domains, including higher education.

In the study of Howard and colleagues, for example, the Dunning-Kruger Effect is explored as a potential explanation for discrepancies between university students' self-perceptions and their actual reading proficiency. The study found that many students rated their competence in academic reading, particularly in understanding scholarly articles, much higher than faculty did. For instance, 59% of students believed they were competent in reading literary journals, while only 11.1% of faculty agreed. This overconfidence aligns with the DKE, as students overestimated their abilities compared to faculty perceptions and actual performance (Howard et al., 2018). In another study by de Brain and colleagues, the authors focus on the manifestation of the DKE in students enrolled in university-level introductory chemistry courses. The study confirmed the DKE's presence by showing that students in the lowest quartile of performance significantly overestimated their understanding and exam results. On average, students who ranked around the 15th percentile perceived themselves as being in the 40th percentile. Illusions of competence are robust and persistent in STEM education, highlighting the need for interventions that target low-performing students' overestimation and high-performing students' underestimation of their abilities (de Bruin et al., 2017).

Our study explores how this effect manifests in university students' literacy and numeracy skills in the first year of a degree in Digital Education at the University of Modena and Reggio Emilia. Literacy and numeracy are essential competencies in higher education. Using ISFOL definitions, literacy involves reading comprehension, writing, and communication skills, while numeracy refers to the ability to interpret and work with numerical information (2014). These basic skills are the foundation for more advanced learning, and accurate self-assessment of these skills is essential for academic success. Metacognitive awareness, the ability to reflect on one's cognitive processes and assess one's knowledge, plays a crucial role in learning (De Santis et al., 2021). Individuals with high metacognitive awareness are more likely to make accurate self-assessments and recognize areas for improvement. In the context of the DKE, poor metacognitive skills may exacerbate overconfidence in low-performing individuals, as they cannot acknowledge their knowledge gaps.

Despite the importance of numeracy and literacy, very few studies have been found on major scientific databases (Scopus). The research using the string “Dunning” AND “Kruger” AND “effect” AND “Literacy” shows 17 results, and just 2 results using “Numeracy”.

For this reason, our study wants to contribute to scientific evidence in this field, so aims to investigate whether students, mainly those newly enrolled in university, are prone to the DKE when assessing their literacy and numeracy skills. The focus is on students enrolled in the first year of the Digital Education degree at the University of Modena and Reggio Emilia. This research examines how students' self-assessed abilities compare to their actual performance and explores the role of metacognitive awareness in moderating these judgments.

2. Method

We administered three questionnaires to the first-year students of the Digital Education degree course at the University of Modena and Reggio Emilia (Italy).

The first two questionnaires regard literacy and numeracy. In addition, to detect data on metacognition, we administered Metacognitive Awareness Inventory (Schraw & Dennison, 1994) to students.

The literacy questionnaire, which focuses on reading comprehension, is scored on a scale of -10 to 30. Each of the 10 questions carries a penalty of 33% for incorrect answers, allowing students to obtain a final score within this range.

The numeracy test, which mirrors the structure of the Professional Skills Tests used in England to obtain Qualified Teacher Status, QTS, is an assessment of the students' numerical abilities. It is made up of two parts: The mental Section (12 questions) and the Written Section (16 questions), and the score that students can obtain is between 0 and 30 (no penalties).

For both the tests, the passing grade is 18.

Before completing the tests, students rated their perceived performance on a scale from -10 to 30 for the literacy test and from 0 to 30 for the numeracy test. They replayed the questions:

- "How competent do you think you are in text comprehension? Indicate the grade you will get on the literacy test".
- "How competent do you think you are in numeracy? Indicate the grade you will get in the numeracy test".

Therefore, two variables were available for literacy and numeracy: the score obtained during the test and the score declared by students in the self assessment.

For the analysis, the authors introduce an index calculated as the ratio between Self Assessment Score (SA) and Achieved Score (L or N).

As in Figure 1, the index called SAI (Self Awareness Index) is equal to 1 when the achieved score coincides with the self assessment score; the perceived and obtained results overlap.

SAI is higher than 1 when self assessment scores are higher than the test scores; students overestimate their abilities.

SAI is lower than 1 when self assessment scores are lower than the real ones; students underestimate their performance.

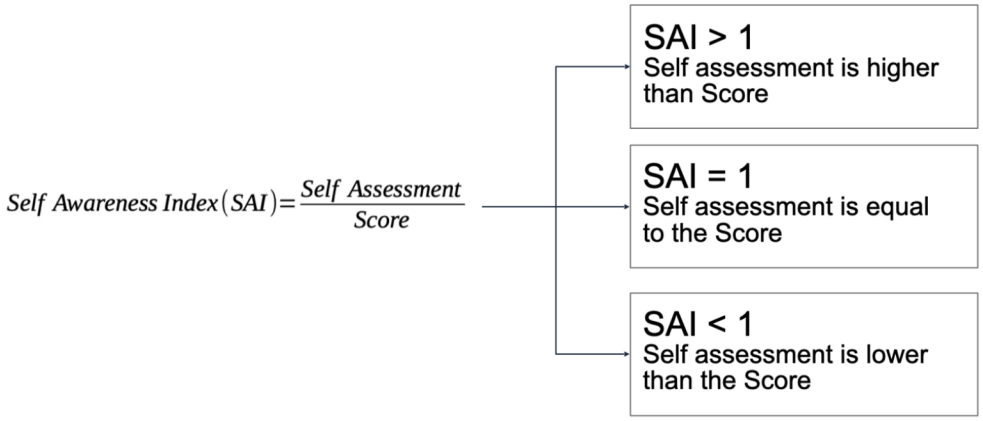

Figure 1 - Self Awareness Index.

3. Results

89 students in the Digital Educationdegree course participated in the investigation.

After removing incomplete answers, our sample was composed of 67 units for the literacy test and 70 units for the numeracy test.

76% of the sample are women. Median age was 21 (range 18-57). 87% of the participants declared that they were attending a degree course for the first time.

Figures 2 and 3 show the distribution of the score for the two questionnaires. In both cases, the range of self assessment scores is wider than the achieved score.

For literacy (Figure 2), students choose their perceived grade (SA) between -10 and 30. Their test grade (L) is between 0 and 30; no negative score has been obtained. In students' perception, the scores (SA) more frequently chosen are between 15 and 25; the real scores (L) are higher than 20. The median score for SA is 20, and for L is 22.

For numeracy (Figure 3), students choose their perceived grades (SA) in a range between 0 and 30. Their test scores (N) are distributed with similar frequencies from 10 to 27. Students' most frequently perceived scores are between 15 and 25 (with a peak of 18). The median score for SA is 18, and for N is 20.25. We observed a high correlation (0.82) among the perceived scores for numeracy and literacy: the variables follow the same trend in both tests, and students have similar

perceptions of their performance in the two tests regardless of ability. There is no high correlation between SA and L (0.06) for literacy and between SA and N for numeracy (0.23).

We calculated the correlation between the score obtained in the Metacognitive Awareness Inventory and the difference between the grades of SA and test score for literacy and numeracy. The correlation value is low in both cases. In detail, *r* is 0.11 between SA and L; 0.01 between SA and N.

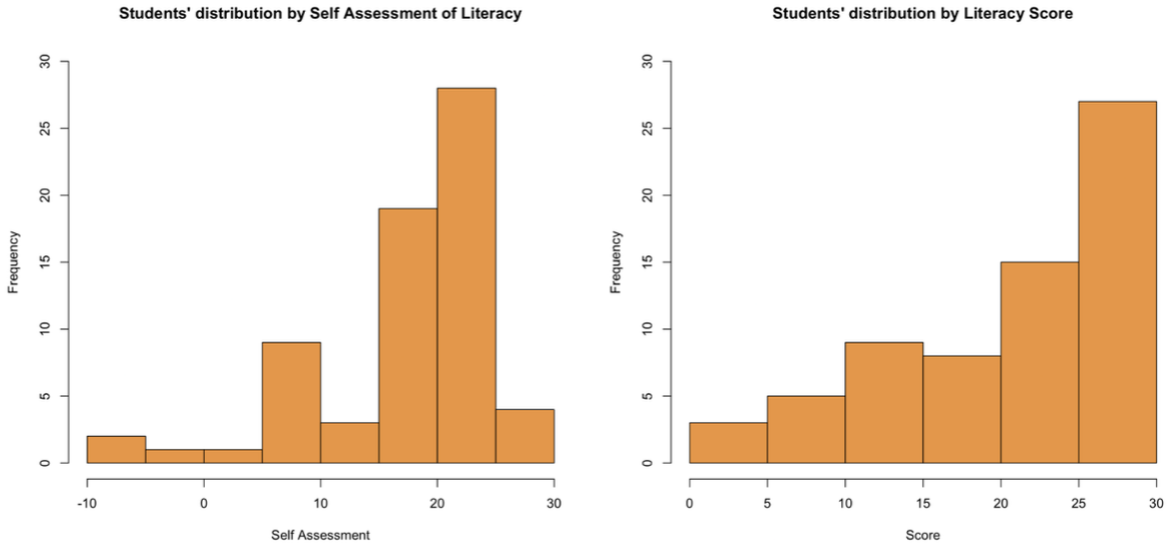

Figure 2 - Students' distribution by self assessment score (SA, *left*) and test score (L, *right*) for Literacy test.

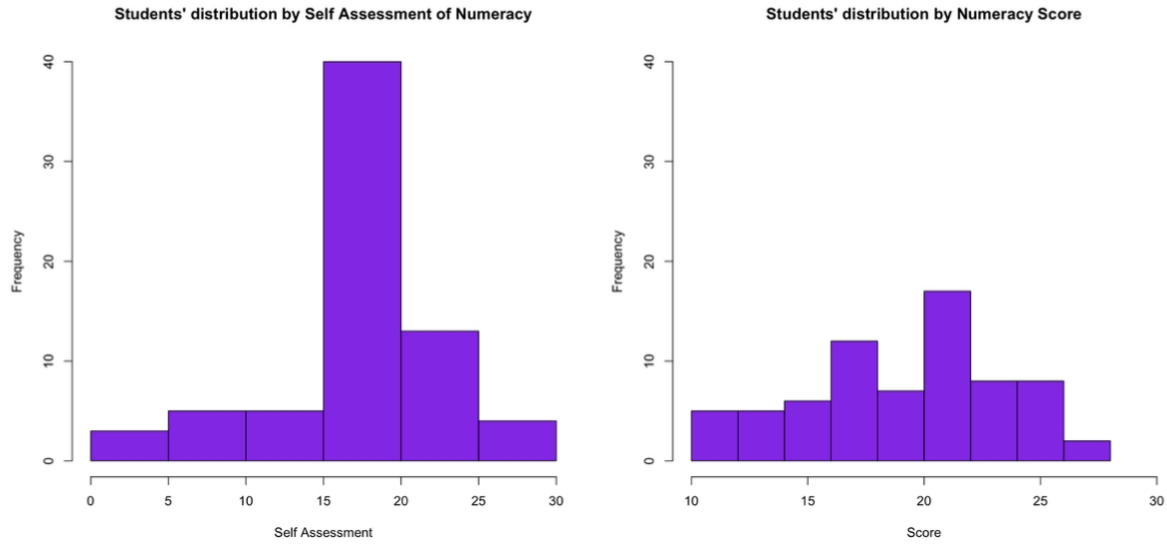

Figure 3 - Students' distribution by self assessment score (SA, *left*) and test score (N, *right*) for Numeracy test.

Figures 4 and 5 represent the graphs obtained plotting Self Awareness Index vs Score. They show the Dunning-Kruger effect.

The black dots (very few in the two graphs on the dotted line equal to one) represent the students who indicated the score they then actually got.

The red points indicate the students who overestimate their ability, and the green points are those who underestimate their scores.

The red points at the top left are the students with a low level of ability who consider their scores very high. The green points in the bottom right quadrant are those who have good abilities but have underestimated their readiness.

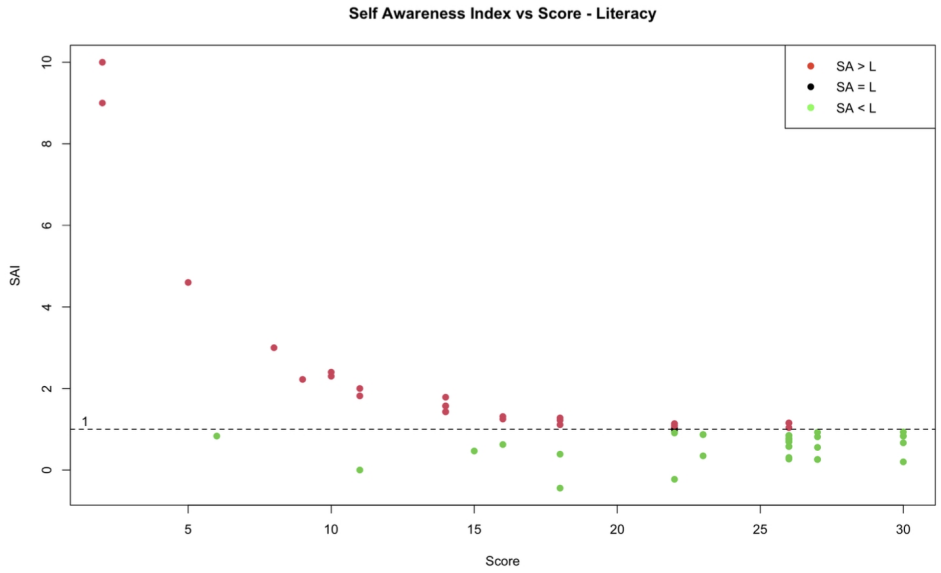

Figure 4 - Self Awareness Index vs Score - Literacy test.

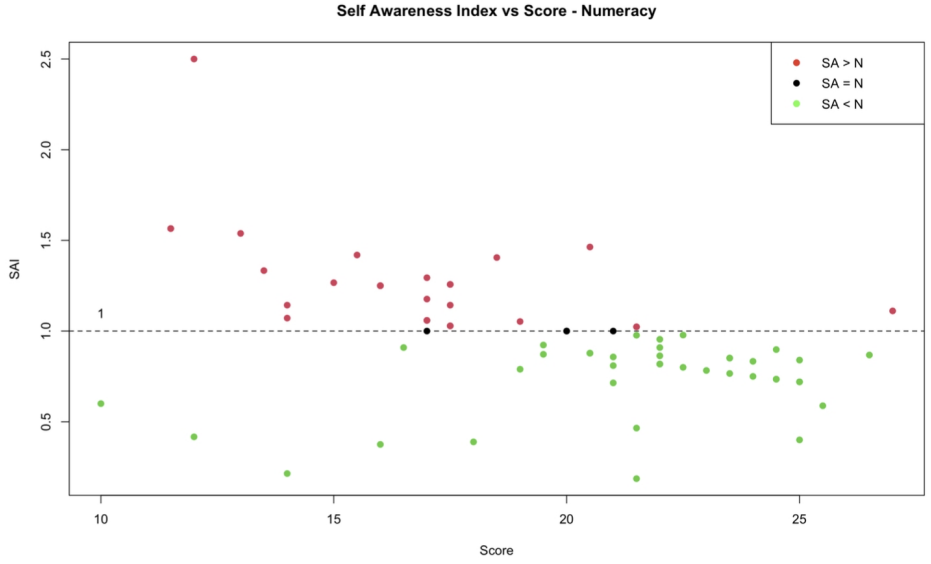

Figure 5 - Self Awareness Index vs Score - Numeracy test.

Moving to the DK effect on teaching and considering only the test score, we see the students who passed the literacy test are 47 (70%). For numeracy, they are 43 out of 70 total (61%).

Tables 1 and 2 show the confusion matrices indicating how many students correctly interpreted their readiness to pass or fail the tests. For the literacy test, their percentage got to 58% (39 students). 16 students (24%) thought they would pass the test and instead failed, and 12 students (18%) thought they would fail the test and instead passed it.

For numeracy, the percentage of students correctly indicating if they will pass or fail the test reaches 60%. 19 students (27%) thought they would pass the test and instead failed, and 9 students (13%) thought they would fail the test and instead passed it.

	Passed (L)	*Failed (L)*	*Sum*
Passed (SA)	35 (52%)	16 (24%)	51 (76%)
Failed (SA)	12 (18%)	4 (6%)	16 (24%)
Sum	47 (70%)	20 (30%)	67

Table 1 - Confusion Matrix for Literacy.

	Passed (N)	*Failed (N)*	*Sum*
Passed (SA)	34 (49%)	19 (27%)	53 (76%)
Failed (SA)	9 (13%)	8 (11%)	17 (24%)
Sum	43 (61%)	27 (39%)	70

Table 2 - Confusion Matrix for Numeracy.

In more details, looking at the self perception of abilities, we can say for literacy that:

- *In the Self Assessment for only 2 students SA = L.*
  They passed the test.
- *In the Self Assessment for 28 students (42%) SA > L.*
  All of them declared to pass the test. 16 of them failed the test.
- *In the Self Assessment for 37 students (55%) SA < L.*
  16 of them declared to fail.
  Only 4 really failed the test.

For numeracy:

- *In the Self Assessment for only 4 students SA = N.*
  3 passed the test, 1 failed.
- *In the Self Assessment for 27 students (39%) SA > N.*
  Only 2 of them declared to fail.
  21 of them failed the test.
- *In the Self Assessment for 39 students (56%) SA < N.*
  14 of them declared to fail.
  Only 5 really failed the test.

As teachers or educational researchers, our attention usually focuses on students who didn't pass the test and for whom the training was unsuccessful. In addition, given these results, we have to question ourselves on students who failed the test thinking instead they were at an advanced level and those who passed the test thinking they would fail.

4. Discussion

The results presented here, involving first-year students with a Digital Education degree, underscore the profound significance of the Dunning-Kruger Effect (DKE) in the literacy and

numeracy skills self-assessment. We found a compelling alignment with the general characteristics of the DKE, demonstrating that students with lower actual performance tend to overestimate their abilities, while those with higher performance more accurately assess or slightly underestimate their skills, both in literacy and numeracy domains.

In terms of literacy, the data reveal that the students' perceived scores (SA) tended to cluster in the 15–25 range, while their actual scores (L) were slightly higher, with a median of 22. Data indicate that although students believed they were performing adequately, there was still a tendency for overestimation, particularly among lower-performing students. The numeracy results follow a similar trend. The median perceived numeracy score (SA) was 18, while the actual test scores (N) showed a higher median of 20.25. The numeracy test produced a wider distribution of self-assessed scores compared to literacy, but like literacy, the students with lower scores were more likely to overestimate their abilities.

We add some observations about the findings:

- Further analysis is necessary to deepen our understanding, mainly focusing on the potential connections between self-assessment accuracy and other academic or personal factors such as study habits or prior educational experiences.
- Further research is necessary on self-assessment accuracy. Students with low metacognitive awareness are consistently inaccurate in evaluating their overall academic abilities, not just in specific subjects.

The low number of participants limits this investigation. Despite this, this study provides valuable insights into the Dunning-Kruger Effect and its influence on first-year university students' self-assessment of literacy and numeracy skills. We would in future expand the research to involve a more extensive and diverse sample (es. other degree students or PhD students) would allow for broader generalizations and offer a more comprehensive view of how the Dunning-Kruger Effect manifests across different demographics and educational contexts.

In addition to literacy and numeracy, our intention for future research is also to explore how digital competences are affected by students' self-assessment biases. Given the increasing importance of digital skills in education and the workforce, investigating students' perceptions of their digital abilities could provide useful insights for developing more targeted educational interventions. Improving metacognitive awareness in the digital domains, alongside literacy and numeracy, will be crucial to fostering well-rounded, competent learners prepared for the demands of modern education and beyond.

Authors' contribution

According to CRedit system Claudia Bellini (corresponding author): Conceptualization, Resources, Writing - Review & Editing; Annamaria De Santis: Investigation, Formal analysis, Visualization, Data Curation; Katia Sannicandro: Resources; Tommaso Minerva: Conceptualization, Methodology, Supervision.

References

De Bruin, A. B., Kok, E. M., Lobbestael, J., & de Grip, A. (2017). *The impact of an online tool for monitoring and regulating learning at university: Overconfidence, learning strategy, and personality*. Metacognition and Learning, 12, 21-43.

De Santis, A., Sannicandro, K., Bellini, C., Cadamuro, A., & Minerva, T. (2021). *Students' academic achievements: clusters based on metacognition, literacy and numeracy skills*. GIORNALE ITALIANO DI EDUCAZIONE ALLA SALUTE, SPORT E DIDATTICA INCLUSIVA, 5(2), 89-101.

Dunning, D., Johnson, K., Ehrlinger, J., & Kruger, J. (2003). *Why people fail to recognize their own incompetence*. Current Directions in Psychological Science, 12, 83–87.

Howard, P. J., Gorzycki, M., Desa, G., & Allen, D. D. (2018). *Academic reading: Comparing students' and faculty perceptions of its value, practice, and pedagogy*. Journal of College Reading and Learning, 48(3), 189-209.

Istituto per lo sviluppo della formazione professionale dei lavoratori (ISFOL) (2014). *PIAACOCSE , Rapporto nazionale sulle Competenze degli Adulti*. Retrieved from https://www.isfol.it/piaac/Rapporto_Nazionale_Piaac_2014.pdf

Ivory, J., & Gean, S. (1991). *A paradigmatic Analysis of Contemporary IT development.* European Journal of IT, 1(4), 249-272.

Kruger, J., & Dunning, D. (1999). *Unskilled and unaware of it: how difficulties in recognizing one's own incompetence lead to inflated self-assessments*. Journal of personality and social psychology, 77(6), 1121.

Maki, R. H., Jonas, D., & Kallod, M. (1994). *The relationship between comprehension and metacomprehension ability*. Psychonomic Bulletin & Review, 1, 126-129.

Schraw, G., & Dennison, R. S. (1994). Assessing metacognitive awareness. *Contemporary Educational Psychology*, 19, 460-475.

Urban, M., & Urban, K. (2021). *Unskilled but aware of it? Cluster analysis of creative metacognition from preschool age to early adulthood*. The Journal of Creative Behavior, 55(4), 937-945.