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Research Article

From Overconfidence to Insight: The Role of Experiential Learning in Developing Critical Reading and Self-Assessment Accuracy Among Undergraduate Students

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Abstract

Critical reading of scientific literature is a fundamental skill for undergraduate students in the life sciences. While traditional pedagogical approaches largely focus on direct instruction, reflective writing, and pre/post assessments, less is known about how repeated experiential engagement with primary literature—through tasks such as oral presentations and structured self-evaluation—shapes the development of accurate self-assessment and critical reading skills over time. The methodological approach of this study uses longitudinal comparison of self-ratings and instructor grades to follow undergraduate biotechnology students over two consecutive semesters during which they presented scientific articles and completed self-rating questionnaires. Instructor evaluations and student self-assessments were compared across semesters, with a specific focus on differences between high- and low-achieving students. Although no significant differences were found between the grades assigned by the instructor for the two semesters, the students—particularly the high-achieving ones—demonstrated improved self-calibration over time, as evidenced by a decreasing gap between their self-ratings and the grades they received from the instructor. Over time, low-achieving students continued to overestimate their performance on overall self-assessments, but showed growing awareness of specific difficulties, suggesting that while global self-assessment accuracy may be slower to develop, metacognitive insight can still emerge through structured reflection. The concurrent shift in students' perceptions regarding which sections of a paper were the most difficult to understand—from the Introduction in the first semester to the Results and Discussion sections in the second—indicated deeper engagement with the structure and demands of scientific texts over time. These trends, together with increased student confidence and decreased anxiety about presenting, underscore the importance of repeated experiential learning, feedback, and reflection for fostering both critical reading skills and self-regulated learning.

Keywords

Critical Reading, Scientific Literacy, Self-assessment, Metacognitive Development, Experiential Learning, Undergraduate Science Education, Presentation-based Learning, Self-evaluation Accuracy

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1. Introduction

Critical understanding of research articles and accurate presentation of scientific results are fundamental skills for life-science careers [1]. Critical reading of research articles requires familiarity with article structure and the conventions of scientific writing, knowledge of technical terms, understanding of experimental procedures, and the ability to interpret data analyses. Based on the information presented in an article, critical readers can judge if the controls for experiments were set properly, compare their independent interpretations of the results with the ones presented in the paper, and identify avenues for further research. Critical reading requires professional knowledge and experience that is not expected from undergraduates, but reading of primary scientific literature during undergraduate studies can help undergraduate students to develop critical thinking skills, when it is accompanied by supervision and instruction [2, 3]. The importance of exposing undergraduates to scientific publications is recognized internationally and such material is included in science-education curricula around the world. The ability to read and understand scientific articles is necessary for both lifelong learning and short-term employability [4, 5].

Along with critical-thinking skills, effective communication skills are also in high demand in the job market and are considered skills that should be developed during academic studies [6, 7]. Students recognize the importance of developing effective communication skills, since such skills may help broaden their employability [8]. Effective communication skills include the ability to present information orally, in a concise, understandable, and confident manner. Oral presentations of scientific literature usually follow the paper's structure and include an introduction, followed by a discussion of the methods used, the results obtained, and the significance and implications of those results. For inexperienced undergraduates, oral presentation of scientific papers in front of peers and instructors presents many challenges [9].

Approaches to exposing undergraduates to primary literature tend to focus on reading and writing assignments [2, 3, 10] or on journal club and seminar presentations of published literature [9, 11, 12]. These approaches have been shown to improve students' confidence regarding their understanding of primary literature and to enhance their critical-thinking skills [13]. Those outcomes are usually assessed using questionnaires [14] or pre- and post-session tests [3]. Training students in reading primary literature has been found to improve their comprehension and critical-thinking skills over time [3, 15].

Research on students' oral presentations shows that these presentations promote self-awareness and aid the development of self-regulation, which are both necessary professional skills [16]. In the context of learning, self-regulation is defined as the ability to identify academic strengths and weaknesses and the capacity to target and improve weak areas [17, 18]. Zimmerman's model of self-regulated learning conceptualizes learning as a cyclical process involving forethought, performance monitoring, and self-reflection [24]. By engaging students in repeated cycles of planning, presenting, and evaluating their performance, the structure of this study supports the development of metacognitive skills central to Zimmerman's framework. However, as observed in this and previous studies, not all students benefit equally from such reflective opportunities. In particular, the Dunning-Kruger effect helps explain why low-performing students often overestimate their abilities due to limited metacognitive awareness, while high-achieving students tend to make more accurate or even conservative self-assessments [20, 21]. This disparity suggests that while all students are exposed to the same learning and feedback processes, the degree to which they can effectively regulate and recalibrate their self-perceptions differs. This theoretical contrast highlights the need to observe how students' self-assessment patterns evolve over time in authentic academic tasks—yet few studies have systematically tracked students' self-ratings across multiple presentations of scientific literature to examine the longitudinal development of their critical-thinking and self-regulatory abilities. This study contributes to that gap by examining how repeated experiential engagement—through structured oral presentations and reflective self-assessment—supports the longitudinal development of critical reading and self-evaluation accuracy among undergraduate students.

2. Materials and Methods

2.1. Participants

Forty-six students were enrolled in the first-semester course and 58 students were enrolled in the second-semester course. Thirty-eight students participated in both courses, gave their consent to participate in this study, and completed the self-rating questionnaires each semester.

2.2. Presentation Requirements

Students were asked to choose one research paper addressing basic scientific research that was published within the last 5 years in a peer-reviewed journal with an impact factor of 3 or higher. They were asked to read the paper and then give an oral presentation about it. The oral presentation needed to be accompanied by a PowerPoint presentation that included an introduction, the research aim or hypothesis, the overall experimental design, three major results, and a conclusion slide. Guidelines were presented to the students prior to the presentation dates, along with examples of common mistakes and tips for successful presentations. The presentation time was set for 10 minutes, with an additional 10 minutes for questions from the audience and the instructor.

Students were required to complete a self-rating questionnaire no later than 1 week after their presentation. Students' comments and answers to the questionnaire were not viewed until both semesters had ended and all grades had been assigned. In the first semester, students could choose to present alone or in pairs. During the second semester, presentations were given online in synchronous lessons.

2.3. Instructor Evaluation

The presentation evaluation included the following subjects, which were each assigned a relative weight:

1) Presentation content according to the given rubric, 35%
2) Delivery of presentation, with an emphasis on continuity and the flow of the talk, avoidance of reading prepared notes, and direct connection between slide content and communication with the audience: 35%
3) Answers to questions from the audience and instructor: 30%.

The instructor's evaluation rubric was published on the course website prior to the talks. During the first semester, students received written feedback from the instructor two weeks after their presentation, after they had completed the self-rating questionnaire. Final grades for the first course were published between the semesters, prior to the beginning of the student presentations in the second semester.

2.4. Self-Assessment Questionnaire

The questionnaire included six multiple-choice questions and one optional, open-ended question. The multiple-choice questions included three 4-point Likert-scale questions, two closed questions in which paper sections were chosen from a pull-down menu, and one self-evaluation question that asked students to rate their talk using a 10-point pull-down scale ranging from 50 to 100.

In the second semester, an additional yes/no question was added to the questionnaire: Do you think that filling in the self-rating questionnaire in the previous semester helped you in any way in the current course? An English translation of the questionnaire is presented as Supplementary File 1.

2.5. Statistical Analysis

Statistical analysis was performed using Excel and R Studio (version 4.3.1). Data are presented as means ± standard error of mean (*SE*) or standard deviation (*SD*). Paired two-sample *t*-tests were used to compare groups between semesters and two-sample *t*-tests were used to compare data within the same semester. Spearman correlations were used to check for correlations between students' answers. *p*-values of less than 0.05 were considered statistically significant.

3. Results

3.1. No Difference in Instructor Grades Between Semesters

Initially, instructor grades were compared between semesters. No statistically significant differences were observed between the final grades given in the first and second semester, between the grades of women and men, or between the grades of students from different ethnic groups (Table 1). For students who took both courses, there was no trend of improvement or decline in students' grades between the semesters. In the second semester, 32% of the students received grades that were within 3 points of their previous grade, 34% received a grade that was three or more points lower than the grade they received in the first semester, and 34% of the students received a grade that was three or more points higher than the grade they received in the first semester.

Table 1. *Average instructor grades for the entire class in the first and second semesters.*

	First semester average grade ± *SD*	**Second semester average grade ± *SD***
Women	90 ± 7 (n = 35)	90 ± 9 (n = 46)
Men	89 ± 9 (n = 11)	91 ± 5 (n = 12)
Arab ethnicity	90 ± 7 (n = 29)	89 ± 9 (n = 37)
Jewish ethnicity	90 ± 8 (n = 17)	92 ± 5 (n = 21)

3.2. Students Identified the Results Section as the Most Difficult to Understand

Students were asked to rate which part of the research paper was the easiest for them to understand and which was most difficult. Similar to what was observed by Hubbard and Dunbar [1], in this study, the students stated that the Results section was the most difficult for them to understand and found the aim of the research easiest to understand. The percentage of students who chose the Results section as being most difficult to understand increased from 32% to 43% in the second semester. One of the course requirements was to outline the experimental design used in the study reported in the chosen paper, according to the Results section. Students found this very challenging (32% in the first semester, 34% in the second semester), indicating again that the Results section was the most difficult section for them to understand. Another shift was noticed in students' perception of the Introduction as difficult to understand. During the first semester, 26% of the students reported that the Introduction was the most difficult section to understand. This number dropped by half to 13% during the second semester. It should be noted that students

were not asked to present the Methods section and were not asked about their ability to understand that section.

3.3. Adjustment of Student Self-Rating Between Semesters

No later than 1 week after their presentation and before receiving written feedback from the instructor, students were asked to fill out a self-rating questionnaire (Supplementary File 1). Two weeks after their presentation, students received written feedback from the instructor, which did not include a numeric grade. A final course grade was published for the first course before the beginning of the second one. Students' answers to the questionnaires were analyzed only after both courses had ended.

Among the students who presented papers both semesters (n = 38), a difference was observed in the self-ratings during the two semesters. In the first semester, these students' self-rating grades were, on average, 6 points lower than the grades they received from the instructor ($p < 0.01$), but in the second semester, their ratings were, on average, only 4 points lower than the grades assigned by the instructor. This difference between the semesters was not statistically significant ($p > 0.05$), but may still suggest that students who participated in self-rating and received a written and numeric grade from the instructor for their first presentation were better able to assess their subsequent performance. It should be noted that the students rated themselves by choosing a number between 50 and100 that was a multiple of 10 (e.g., 50, 60, 70); whereas the instructors' grade was not necessarily a multiple of 10 (e.g., 84, 79, 63). This may also explain some of the differences between the self-ratings and instructor-assigned grades.

3.4. Analysis of Upper and Lower Quartile Responses

Further analysis of the students' responses during the two semesters concentrated on the upper and lower quartiles of class grades, in which trends were more apparent. The difference between the upper and lower quartiles of instructor-assigned grades was statistically significant ($p < 0.001$). Four of the 10 students in the upper quartile kept their position in both semesters and 4 of the 9 students in the lower quartile remained in that quartile for both semesters.

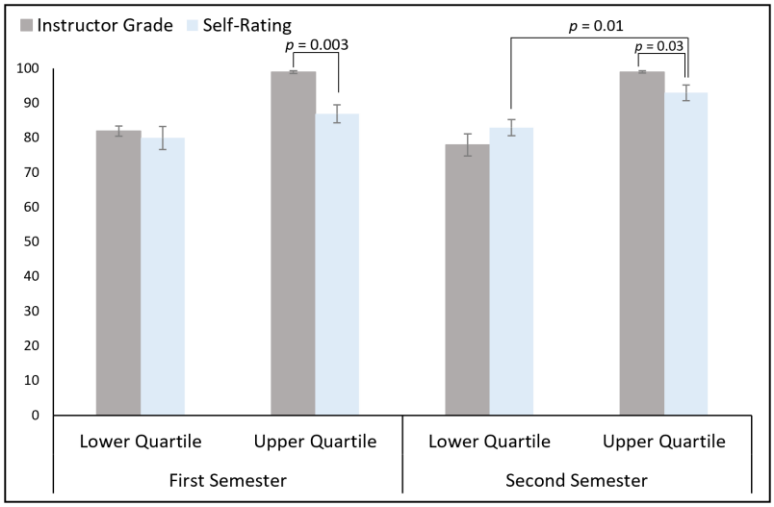

Figure 1. *Instructor grades (gray bars) and students' self-ratings (light-blue bars) of their talks in the first and second semesters, for the lower (n = 9) and upper (n = 10) quartiles only. Error bars represent SE.*

In both semesters, students from the upper quartile assigned themselves grades that were significantly ($p < 0.05$) lower than those they received from the instructor, although this difference decreased in the second semester (Figure 1), indicating the ability to calibrate self-evaluation after one semester. Students of the lower quartile did not underestimate their grades in the first semester and, in the second semester, the lower-quartile group tended to overestimate their performance with respect to the instructor grade (Figure 1, $p > 0.05$). These results are congruent with those of other studies [19, 20], which have shown that students with higher grades tend to underestimate their performance; whereas students with lower levels of achievement tend to overestimate in self-rating. These results also indicate that the students with the lowest class grades did not demonstrate an ability to recalibrate their grades after one semester.

3.5. Critical Reading Development as Assessed Through Answers to Short Reflective Questions

Students were asked to rate the ease of finding a scientific paper for their presentation and the ease of understanding the paper that they chose, using a scale of 1 (*very easy*) to 4 (*very*

difficult). In the first semester, students in both the upper and lower quartiles reported similar values for the ease of finding a paper. However, during the second semester, upper-quartile students were more likely to say that it was easy to find a paper ($p > 0.05$, Figure 2).

A difference in students' reported understanding of the papers was also noted between the semesters. In the first semester, students who received relatively low grades from the instructor reported that it was relatively easy for them to understand the papers that they chose, as compared to their peers who received the highest grades in the course. However, this difference was not statistically significant. In the second semester, students from the lowest quartile were significantly more likely to report that it was difficult to understand the paper, as compared to their peers who received the top grades in that class. The students who got top grades during the second semester were significantly more likely to report that it was relatively easy for them to understand the papers they chose, as compared to those who got top grades during the first semester and as compared to their peers who received the lowest grades for the second semester (Figure 2).

Correlation analysis of students' ratings of their talks supported the differences seen in the reported ease of understanding the papers (Table 2). Only during the second semester, significant medium-level correlations were found between instructors' grades and students' self-ratings of their talks. This correlation was corroborated by students' ratings of their PowerPoint presentations ("Presentation" in Table 2). In addition, a medium-level negative correlation was found between students' rating of their understanding of the paper they chose to present and grades they received from the instructor. That is, students who noted difficulties in understanding the paper (3 or 4 on the Likert scale) received lower grades for the course.

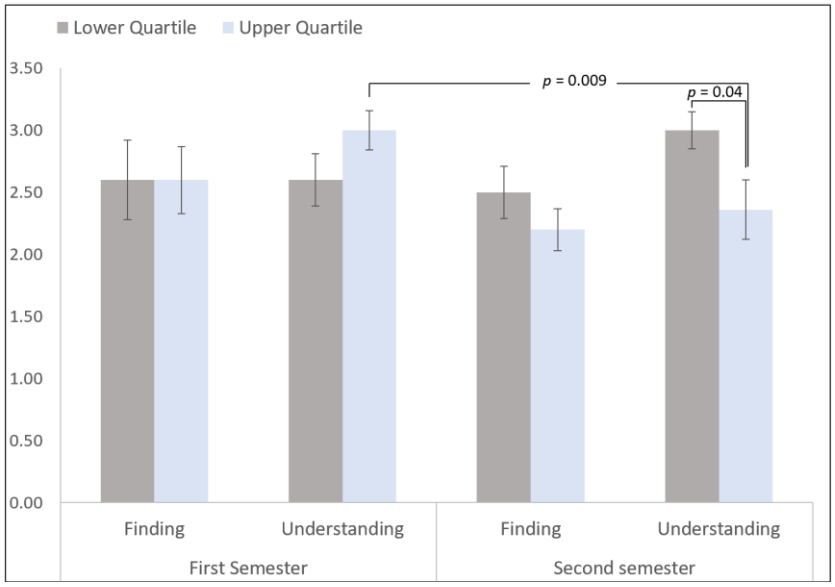

Figure 2. *Ease of finding a research paper and understanding it during the first and second semesters, among students in the upper (light blue, n = 10) and lower (gray, n = 9) grade quartiles. Student responses were given on a scale of 1-4: 1 = very easy; 4 = very difficult. Error bars represent SE.*

Table 2. *Rho values for Spearman correlation analysis of upper- and lower-quartile answers in the second semester.*

	Instructor	Self-rating	Presentation	Understand	Find
Instructor	1				
Self-rating	0.61**	1			
Presentation	0.15	0.53*	1		
Understand	-0.55*	-0.39	0.02	1	
Find	-0.19	0.18	0.32	0.00	1

Instructor = grade given by the instructors; Presentation = students' ratings of how well their PowerPoint presentations adhered to the guidelines; Understand = students' rating of their understanding of the paper; Find = students' rating of the ease of finding a suitable paper for their talk. *$p < 0.05$; **$p < 0.01$.

3.6. Thematic Analysis of Students' Remarks

The only open-ended question in the questionnaire was titled "Remarks" and was optional. In the first semester, 35% of the students chose to add a remark. In the second semester, 26% did so. In the first semester, the students' comments concentrated on four main topics: being nervous and stressed, the process of preparing for the presentation, the time constraints for the talk, and self-congratulation (Table 3). As noted in the Methods section, students could choose to present in pairs during the first semester. Therefore, some of the remarks in the questionnaires were in plural form, even though the students filled out the questionnaire individually.

Table 3. Students' remarks during the first semester.

Topic	Incidence	Example
Stress, nervousness	44%	I was a little nervous at the beginning…I remembered the time constraints…I gave everything I could, but I expected to be calmer.
Preparation process	38%	Our main effort in making the presentation was to analyze the paper and summarize it, to make it accessible for someone who did not read it…
Time allotted for talk	31%	I know the talk took more than 10 minutes; that's because of my seriousness regarding my work…
Self-congratulation	31%	I think we did a good job and the presentation was clear, accessible, easy to understand and aesthetic…

Remarks are translated from the original Hebrew.

During the second semester, the topic of stress and excitement did not come up in the remarks. However, two additional topics did come up, as presented in Table 4. During the second semester, students gave their talks online.

Table 4. Students' remarks during the second semester.

Topic	Incidence	Example
Preparation process	31%	I had difficulties in understanding the Introduction and had to search more to understand more. I didn't have to do these things in the first semester….
Time allotted for talk	31%	I think more time is needed for the talk because choosing to present a new topic is interesting, but requires more time to explain.
Self-congratulation	15%	I think I gave a good and interesting presentation, even though the discussion was hard to understand, I did my best to convey clearly even the part that was difficult for me…
Presenting online	38%	Presenting online was really challenging, even harder than giving a talk in class because for me personally it was hard not to feel the class and I think it is boring for the audience to only look at the presentation and listen….
Course summary	23%	The presentation we gave in the first semester and the instructions and remarks were very helpful for presenting a paper according to guidelines.

Remarks are translated from the original Hebrew.

3.7. Students' Impressions Regarding the Helpfulness of Having Completed the Self-Rating Questionnaire for the First Semester

In the second semester, an additional yes/no question was added to the questionnaire: Do you think that filling in the self-rating questionnaire in the previous semester helped you in any way in the current course? Sixty-six percent of the students answered *yes*. There was no correlation between the answer to this question and any of the other questions and *yes* and *no* answers were equally distributed across the entire range of grades.

4. Discussion

The current study offers unique insights into how undergraduate students with little to no prior experience in critically reading scientific literature develop more accurate self-assessment abilities over time. Unlike previous studies that have emphasized direct instruction, reflective writing, and traditional forms of assessment [2, 3], this research highlights the role of experiential learning—specifically article presentations and structured self-evaluation—in promoting critical reading skills. Furthermore, it identifies distinct self-regulation patterns among different groups of students.

Even after gaining experience, receiving feedback, and engaging in self-reflection, a clear gap remained between high- and low-achieving students, in terms of their ability to accurately assess their own performance. High-achieving students initially underestimated their performance, but gradually developed improved self-calibration, as evidenced by a reduced gap between their self-ratings and the grades they received from the instructor (Figure 1). These students also demonstrated greater accuracy in evaluating their performance of specific elements of the task, such as their understanding of the research article, after one semester of experience.

In contrast, low-achieving students continued to overestimate their overall performance, even after structured feedback and reflective practice. No improvement was found in the alignment of their self-assessments with the instructor's evaluations. These results are consistent with previous findings on overestimation in self-assessment among low-performing students [21, 22]. However, a more nuanced picture emerged from this study. Specifically, low-achieving students began to demonstrate awareness of specific areas of difficulty. In particular, their responses to targeted questions—such as the perceived difficulty of understanding the article—revealed a higher level of challenge, as compared to their peers (Figure 2), suggesting the early development of metacognitive insight.

This recognition of specific challenges was further supported by a significant negative correlation between students' reported understanding and the grades they received from the instructor (Table 2). While high-achieving students reported increased ease of understanding in the second semester, low-achieving students reported greater difficulty. This contrast underscores the potential for metacognitive development even among students who initially overrated their abilities.

A notable shift also occurred in how students perceived the most difficult parts of a scientific article. During the first semester, the Introduction was commonly identified as the most difficult section to understand; whereas in the second semester, the focus shifted to the Results and Discussion sections. This transition suggests a growing sophistication in reading practices and improved comprehension of the structure of a scientific article.

Students also reported increased confidence in presenting and reduced levels of stress and anxiety, reinforcing the value of repeated practice and adaptation. While online presentation did not significantly impact grades, some students noted that the virtual format posed challenges for engagement and presentation dynamics. In this study, the second-semester presentations were conducted online in small groups of 5-6 students plus the instructor, which helped maintain an intimate, supportive, and interactive atmosphere. As shown in Figure 1, no significant differences were observed in instructor-assigned grades or students' self-ratings between the two semesters, aligning with previous findings that suggest comparable academic outcomes across modalities [25]. Furthermore, students did not report increased stress related to the online format, as also observed in prior research [26]. However, the shift to online presentation remains a potential confounding variable, particularly regarding student engagement and peer interaction, and may have influenced subtle aspects of performance or self-perception not captured by grades or questionnaire responses.

Limitations

One limitation of this study concerns the format of the self-assessment scale. Students rated their presentations using a discrete scale limited to multiples of 10 (e.g., 60, 70, 80), while instructor grades were assigned as whole numbers on a continuous scale (e.g., 84, 79). This difference in scale granularity may have influenced the precision of comparisons between student self-ratings and instructor evaluations. Although general trends in over- or underestimation could still be observed, the mismatch in scale format may have introduced minor distortions in measuring self-assessment accuracy and should be considered when interpreting the results.

5. Conclusions

The most important takeaway from this study is that accumulated experience—not instructional method—is the key driver in improving both critical reading and self-assessment accuracy. The reflective process embedded in the course—through structured questionnaires, individual feed-

back, and presentation to peers—emerged as an essential component of learning. The ability to identify specific areas of difficulty contributed directly to improved comprehension and more accurate self-perception, aligning with the findings of previous studies [16, 23].

Finally, this study offers a conceptual contribution by distinguishing between lack of experience and lack of ability. It suggests that inexperienced students are not permanently constrained by the Dunning-Kruger effect. Under conditions of meaningful practice and feedback, they are capable of refining their self-assessment over time with increasing accuracy.

Abbreviations

SE	Standard Error of Mean
SD	Standard Deviation

Supplementary Material

The supplementary material can be accessed at https://doi.org/10.11648/j.sjedu.20251303.12

Author Contributions

Dafna Nathan: Conceptualization, Data curation, Formal analysis, Project administration, Writing - original draft

Iris Gertner-Moryossef: Formal analysis, Writing - review & editing

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Data Availability Statement

The data are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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Biography

Dafna Nathan is a lecturer at the Biotechnology Department of Jerusalem Multidisciplinary College. She completed her Ph.D. in Biophysical Chemistry at Yale University and her postdoctoral training at The Wistar Institute in Philadelphia. Dr. Nathan served as Chair of Practical Engineering in Medicinal Chemistry Program until 2011. At the Biotechnology department she teaches academic reading and writing, bioinformatics, and oversees student seminars and the undergraduate research projects. Dafna is repeatedly recognized for excellence in teaching. In addition, she serves as an academic advisor for third-year biotechnology students and is a member of the campus Teaching Quality Development Group. Dafna is the academic overseer of the Academic Preparatory Program and the Career Development unit of the college.

Iris Gertner-Moryossef is a Senior Lecturer at Hadassah Academic College, School of Management, in Jerusalem. She completed her Ph.D. in Business Administration at the University of Haifa and Pécs University (Hungary), focusing on consumer behavior among first-time mothers. She earned her M.B.A. in Marketing and Organizational Behavior and her B.Sc. in Molecular Biology, both from Tel Aviv University. Dr. Gertner-Moryossef specializes in digital marketing, consumer experience, and technology-enhanced learning. She has received multiple Excellence in Teaching awards and teaches undergraduate and graduate courses in marketing, service management, and digital innovation. She is a member of the college's Teaching Quality Committee and is active in academic research on learning design, consumer behavior, and service evaluation. Dr. Gertner-Moryossef presents at international conferences and provides strategic consulting to public and private organizations. She also leads curriculum development in academic innovation and entrepreneurship.

Research Field

Dafna Nathan: Student self-assessment and self-regulation in experiential learning in higher education, Technology-enhanced active learning, Academic program development in Work Integrated Learning, Critical thinking development using artificial intelligence in higher education, Learning experience design in Learning Management Systems, Development of inquiry-based research projects in structural bioinformatics for undergraduates.

Iris Gertner-Moryossef: Digital technologies in learning environments, Self-directed learning strategies, User experience in online education, Consumer behavior in digital purchasing, Experiential learning and metacognition, Critical reading and self-assessment in higher education, Innovation in academic teaching methods, Service marketing and customer satisfaction, Strategic communication in digital environments.