The literature supports a general theme that college students lack metacognitive awareness about learning, which leads to poor examination performance and ultimately high attrition rates. However, the literature emphasizes that when college students receive instruction about learning, examination performance goes up and attrition goes down.

This pilot study focused on a specific subset of learners: graduate students in a nurse anesthesia program. Given new evidence-based wellness approaches to learning, the nurse anesthesia program conducted a descriptive study aimed at exploring student perceptions. The study goals were to provide students with evidence-based information about wellness factors that influence learning. The book *The New Science of Learning* by Doyle and Zakrajsek (Stylus Publishing, 2013) was used to provide students with neuroscience evidence about learning that might assist their transition to graduate school. The book was mailed to 34 student registered nurse anesthetists before matriculation. An 8-item Likert-style online survey evaluated the students’ perceptions of the book along with identifying any changes the students made in anticipation of starting the rigorous nurse anesthesia program. The study demonstrated that student registered nurse anesthetists could benefit from instruction about wellness approaches that enhance learning before matriculation. Additionally, the study provided the framework for future research.

**Keywords:** Academic success, learning strategies, metacognitive awareness, neuroscience.

A growing body of literature about the neuroscience of learning identifies a gap between what students believe are successful learning strategies and what new research offers. On matriculation into a nurse anesthesia program, students quickly realize that they need to acquire new learning skills because of the increased demands of graduate education. The challenge is severe for some students and results in lower grades and occasionally failure. Some students are dismissed from the program because of multiple failures. The students’ frustration and anxiety result not because they lack the ability, but because they are not aware of learning strategies needed to succeed academically.

Doyle and Zakrajsek offer substantive evidence regarding new learning approaches for college students. Their book *The New Science of Learning* is a little more than 130 pages synthesizing the newest research about how the brain best learns, along with concise and effective tools on how to employ successful wellness-based learning strategies. Doyle and Zakrajsek’s work identifies 4 main areas that students should consider to optimize learning: sleep, nutrition, exercise, and hydration. The evidence clearly indicates that a relationship exists between academic success and attention to sleep, nutrition, exercise, and hydration. In fact, the science shows specifically how each element influences learning. Traditionally, learning strategies focus on specific study skills. Rather, initial attention to the science of sleep, nutrition, exercise, and hydration may positively influence the student registered nurse anesthetist’s (SRNA’s) approach to learning from the start of the graduate program.

Given the new evidence linking sleep, nutrition, hydration, and exercise to learning, the nurse anesthesia program at our institution conducted a prospective descriptive study aimed at exploring student perceptions of newly acquired knowledge about learning. The goal of the study was twofold: (1) provide students with evidence-based learning strategies for promoting academic success and (2) identify how reading the book by Doyle and Zakrajsek influenced the students’ approach to graduate education. This was the first attempt at discerning students’ perceptions of learning strategies using the latest evidence. Ultimately, the nurse anesthesia program hopes to foster academic success and decrease attrition.

**Literature Review**

The literature contains numerous articles addressing the flawed, faulty evaluations that students offer regarding their learning and study behaviors. However, a notable gap exists regarding the possible benefit to SRNAs who proactively receive information about the science of learning. Although this is a unique population of graduate students, the current pilot study addressed specific learning habits of these students. It can no longer be presumed that students are prepared with effective learning strate-
gies because they are graduate students and have accomplished both professional and previous academic success.

Raichlen and Polk\textsuperscript{7} noted in their study that aerobic exercise has the ability to generate, protect, and increase the pliability of the brain along with developing intellect. Despite the well-documented benefits of aerobic exercise, Pauline\textsuperscript{8} indicated a need for exercise promotion in higher education due to the lack of physical activity among this group. Walker\textsuperscript{9} offered confirmation that sleep plays a major part in the processes of learning and memory development. Buboltz et al\textsuperscript{10} verified that virtually 90\% of higher education students reported some type of sleep deficit. Norman\textsuperscript{11} reported the importance of staying well hydrated for ideal brain performance and noted how slight dehydration can affect overall learning capability. Furthermore, Norman stated that a healthy diet is vital to the development of neurotransmitters that form the communication between brain cells, which are imperative for learning to take place. Additionally, Florence et al\textsuperscript{12} established a clear relationship between overall diet quality and academic success.

The neuroscience research regarding the wellness elements that foster learning represents only one aspect to learning strategies. Other literature emphasizes the complex learning requirements characteristic of higher education.\textsuperscript{13-22} Although a full review of the literature is beyond the scope of the current pilot study, meaningful studies are included to emphasize the importance of learning strategies for SRNAs. Sansgiry and colleagues\textsuperscript{18} noted that a high level of academic performance may well be correlated to effective learning and improved study strategies.

Furthermore, to excel in academics at the university, it is essential to learn how to study effectively.\textsuperscript{16} Rowles\textsuperscript{23} posited that while some students do possess this knowledge, most students do not, simply because they have had no formal training on the subject. Some students believe that they can learn everything they need from the professor, and subsequently they lack the resourcefulness needed to seek learning strategies.\textsuperscript{23} Another belief that restricts students’ range of learning strategies is that expertise can be achieved exclusively through traditional means as rote learning.\textsuperscript{1,3} Butler et al\textsuperscript{5} found that metacognitive inaccuracies can ascend from dependence on prompts such as familiarity or fluency that may not indicate whether something is learned. For example, if students test themselves at a reasonable interval from learning, they can discern whether they can produce the material when it is needed. If they do not quiz themselves but merely continue to restudy, the material may seem fluent and easy, but they may not be able to retrieve it after a delay. An important responsibility in educating SRNAs is imparting a commitment to lifelong learning so they will be able to maintain and expand their knowledge and skills to better serve patients, the profession, and society as a whole. Burchard and Swerdzewski\textsuperscript{17} recognized that students with better metacognitive skills are theoretically more proficient at higher-level processing, inferring better academic achievement. It is the charge of faculty to place more responsibility for learning on SRNAs as they advance through rigorous curricula.

Research revealed that the learning strategies a student embraces will affect the quality of learning attained.\textsuperscript{21} Tuckman\textsuperscript{15} showed that college students who received training about learning and study skills had a significant increase in their grade point average (GPA). Fleming\textsuperscript{16} was able to demonstrate that education on study strategy increases examination performance and that teaching these strategies can have long-lasting effects that will pay dividends over time. It is imperative that faculty members place substantial importance on educating students about how to develop healthier study strategies for overall improvement in academic performance. Schools may consider holding seminars or workshops to enhance study strategies.\textsuperscript{18}

A vast amount of literature incorporates 2 main themes: (1) students are unaware of how the brain best learns and (2) integrating students’ knowledge into the curriculum improves GPA and decreases attrition.

Methods
Following approval by the Midwestern University institutional review board, a prospective descriptive survey of 34 SRNAs matriculating in June 2014 was conducted. The Doyle and Zakrajsek\textsuperscript{6} book was mailed to all students accepted to the program during the first week of May 2014, with a request to read the book before matriculation in June 2014. The book accompanied the program's welcome letter. On the first day of class, an email invitation to participate in the study using an online survey link was sent to the first-year class. A follow-up email was sent 1 week later.

An 8-item Likert style online survey evaluated the students’ perception of the book and identified any changes the students made in their approach to learning (Figure 1). The survey was designed by Doyle and Zakrajsek\textsuperscript{6} for use with undergraduate students and was modified for this pilot study with permission from the authors. The survey addressed any benefits the student received from reading the book as well as any personal habits that the student changed as a result of the strategies offered in the book. Completion of the survey was voluntary. Cohort data were analyzed using descriptive statistics and were tabulated. There were no individual identifiers. The data were securely stored in the Nurse Anesthesia Program office at Midwestern University in Glendale, Arizona.

Results
Surveys were returned by 97\% of the students (33 of 34). Thirty (90\%) of the students stated that they had no formal training about learning. When asked if the
students thought it would be helpful to know how their brains learn, 85% (28 of 33) indicated that the information would be very helpful and 15% (n = 5) thought the information would be helpful or somewhat helpful. Only 9%, or 3, of the students reported that they had attended a prior graduate program. When asked how many learning strategies the students applied when learning new material, 78% (n = 26) indicated that they used 2 to 3 methods, which included modification of sleep, exercise, diet, or water intake (Figure 2).

Of the sample, 90% (30 of 33) read The New Science of Learning. Of those who read the book, 28 found it helpful or very helpful. Two students found the book somewhat helpful. Only 3 (9%) of the students had formal training about learning (Figure 3).

When the students were asked whether they knew how they learned best, 24% (n = 8) reported that they understood how they learned best, 70% (n = 23) somewhat knew about how they learned, and 6% (n = 2) reported no knowledge about how they learned. Of the students, 73% (n = 24) reported that they had made a change to their sleep patterns so that they would obtain more sleep on a regular basis. Twelve (37%) of the students added exercise, and 18 (56%) of the cohort changed their hydration patterns such as regularly drinking more water and other fluids. Nearly three-fourths (74%; n = 24) made no changes to their diet, and 36% (n = 12) made some changes to improve their diet.

Of this cohort, 96% of the students (n = 32) changed the way they studied, mirroring how the book says the

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**Figure 1. Survey About The New Science of Learning**

1. Have you had any formal training about learning how to learn?
   - Yes
   - No

2. How helpful would it be to know how your brain learns in order to be successful in a nurse anesthesia program?
   - Very helpful
   - Helpful
   - Somewhat helpful
   - Not helpful

3. Do you know how you learn best?
   - Yes, significantly
   - Yes, somewhat
   - No

4. Have you attended a prior graduate program?
   - Yes
   - No

5. How many learning strategies do you apply when learning new material?
   - 0-1
   - 2-3
   - 4-5
   - 6-7

6. Did you read the book The New Science of Learning?
   - Yes (Please continue with the survey)
   - No (Please discontinue the survey)

7. How would you best describe The New Science of Learning in improving your understanding of how your brain learns best?
   - Very helpful
   - Helpful
   - Somewhat helpful
   - Not helpful
   - No response

8. Did reading this book cause you to change your sleep patterns so that you obtained more sleep on a regular basis?
   - Already had good sleep patterns
   - Yes, significantly
   - Helped
   - Somewhat helpful
   - Not helpful
   - No response

9. Did reading this book cause you to change your exercise patterns so that you exercised more on a regular basis?
   - Already exercised regularly
   - Yes, added significant exercise to my life
   - Yes, added some exercise to my life
   - No change
   - No response

10. Did reading this book cause you to change your hydration patterns so that you drank more fluids/water on a regular basis?
    - Already kept well hydrated
    - Yes, added significant water to my diet
    - Yes, added some water to my diet
    - No change
    - No response

11. Did reading this book cause you to change your diet (food intake) patterns so that you had a more balanced diet?
    - Already had a balanced diet
    - Yes, significantly improved my diet
    - Yes, somewhat improved my diet
    - No change
    - No response

12. Did you change the way you study to bring it into more harmony with how the book says your brain learns?
    - Yes, made significant changes
    - Yes, made some changes
    - No change
    - No response

13. Would you recommend this book be read by all nurse anesthesia students?
    - Yes, very important for them to read
    - No, not necessary for them to read
    - No response

14. Please write an overall evaluation of the book’s helpfulness or failings to improve your learning, study habits, and memory.
brain learns. Notably, 100% of the graduate students recommended the book by Doyle and Zakrajsek for future graduate students in nurse anesthesia (Figures 4-7).

When asked to give an overall evaluation of the book’s helpfulness or failing to improve learning, study habits, and memory, students shared multiple comments, as shown in the Table.

**Discussion**

“I’m sorry that it has taken me this long to learn how to learn. This information would have been helpful earlier in my academic studies.” This comment from an SRNA emphasized the purpose of the pilot study.

The findings of this study established a clear association between providing information about the neuroscience of learning, specifically sleep, nutrition, hydration, and exercise in an effort to optimize learning for SRNAs at the onset of the rigorous curriculum. Moreover, the study demonstrated the willingness for the SRNAs to align behaviors and adopt evidence-based strategies that may improve academic performance. The results of this research correlate well with the previously unpublished results that Doyle and Zakrajsek described when giving a similar survey to undergraduate students. This correlation alongside the literature substantiates the positive influence that students acquire when offered knowledge.
learning strategies. Tuckman and Fleming established evidence-based learning and study strategies. The book increased their metacognitive awareness toward that foster learning. Generally, the students noted that with an easy-to-read and easy-to-incorporate set of skills SRNAs shared a common theme. The book provided them sleep habits. These open-ended comments made by the along with reinforcing the need for a change in food and sleep habits. “[The book] helped me make changes in study habits along with reinforcing the need for a change in food and sleep habits”. These open-ended comments made by the SRNAs shared a common theme. The book provided them with an easy-to-read and easy-to-incorporate set of skills that foster learning. Generally, the students noted that the book increased their metacognitive awareness toward evidence-based learning and study strategies.

Table. What Students Shared About the Book

about how the brain learns best. The literature consistently shows a disparity between what students perceive to be effective learning strategies and what the evidence demonstrates. The current study demonstrated that same disconnect in SRNAs.

Karpicke et al were able to demonstrate the meta-cognitive inaccuracies that students have about learning, whereas research by Ryan and Glenn supports employing learning strategies. Tuckman and Fleming established in their research the significant difference in examination scores and overall GPA of students who received some form of training in learning strategies compared with those who did not. The current study’s attempt at discerning students’ perceptions of learning strategies using the latest evidence proved beneficial, as one student described, “[The book] helped me make changes in study habits along with reinforcing the need for a change in food and sleep habits”. These open-ended comments made by the SRNAs shared a common theme. The book provided them with an easy-to-read and easy-to-incorporate set of skills that foster learning. Generally, the students noted that the book increased their metacognitive awareness toward evidence-based learning and study strategies.

Limitations exist in that this project examined one cohort of SRNAs in one university. The study will need to be replicated, perhaps with multiple programs to generate greater evidence for learning. Additionally, as new students, the subjects may have felt the need to respond positively to the book that was supplied by the program in order to present a positive initial impression to the faculty. Reliability and validity of the survey tool require attention to be able to generalize findings to the larger population. For this reason, the current study results are not generalizable. Rather, this is an initial effort, a descriptive pilot study that explores a new arena for positive approaches to learning for SRNAs.

The current study provides a solid foundation for follow-up data on student performance and attrition. Specifically, future research will examine a correlation between evidence-based learning strategies and GPA as well as attrition for this cohort of SRNAs. Universities have already implemented programs and/or courses to teach learning strategies with success. Future research may inform curricular innovation for nurse anesthesia education and possibly for graduate programs in other disciplines.
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DISCLOSURES

The authors have declared no financial relationships with any commercial interest related to the content of this activity. The authors did not discuss off-label use within the article.