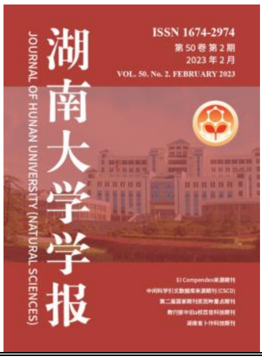

湖南大学学报（自然科学版） 第 50 卷 第 2 期
Journal of Hunan University (Natural Sciences） 2 0 2 3 年 2 月

Available online at http://jonuns.com/index.php/journal/index

Vol. 50 No. 2
February 2023

Open Access Article https://doi.org/10.55463/issn.1674-2974.50.2.6

How Can Blended Learning and GeoGebra Promote Students' Achievement in Calculus during the COVID-19 Pandemic?

Hendra Syarifuddin[1]*, I. Made Arnawa[2], Susila Bahri[2], Nova Noliza Bakar[2], Budi Rahmadya[2], Sri Nita[1], Fitri Adona[1]

[1] Mathematics, Universitas Negeri Padang, Padang, Indonesia

[2] Mathematics, Universitas Andalas, Padang, Indonesia

* Corresponding author: hendrasyarifuddin484@gmail.com, hendras@fmipa.unp.ac.id

Received: December 6, 2022 ▪ Review: January 2, 2023 ▪ Accepted: February 11, 2023 ▪ Published: February 27, 2023

Abstract: Calculus is one of the most important courses to take, especially for those studying science and engineering because it can help them understand concepts and formulas in these fields. The COVID-19 pandemic impacts learning in universities globally. Observations from three colleges in West Sumatera (Padang State University, Andalas University, and Padang State Polytechnic) revealed that during the COVID-19 pandemic, students' achievement was unsatisfactory due to entirely online calculus lectures. The study's main goal was to see how blended learning and GeoGebra-based Calculus courses affected student achievement in online learning. The population of this study consisted of 224 undergraduate students from Andalas University who were enrolled in Calculus courses in the 2021 academic year's odd semesters, divided into four classes: A1, A2, A3, and A4, whereas the research sample consisted of two classes (A1 and A4) with 114 students randomly selected. Lectures were held seven times in the experiment and control classes, using blended learning and GeoGebra aid in the experiment class and fully online learning in the control class. A four-question midterm test was employed in this study as an instrument. The test is based on the learning objectives of the calculus course and has been declared valid by experts in mathematics and mathematics education. The findings show that using blended learning and GeoGebra to teach and learn calculus positively impacts achievement. More student collaboration, more student-centered knowledge growth and engagement, more flexibility in learning and teaching, and a well-balanced array of learning resources and methodologies are all benefits of blended learning and GeoGebra. A significant difference was in calculus achievement between male and female students, and there was no interaction between gender and learning factors toward calculus achievement in online learning.
Keywords: blended learning, calculus achievement, COVID-19 pandemic, gender, GeoGebra.

混合学习和地理坐标如何在新冠肺炎大流行期间促进学生的微积分成绩？

摘要：微积分是最重要的课程之一，尤其是对于那些学习科学和工程的人来说，因为它可以帮助他们理解这些领域的概念和公式。新冠肺炎流行影响全球大学的学习。西苏门答腊三所大学（巴东州立大学、安达拉斯大学和巴东州立理工学院）的观察显示，在新冠肺炎 大流行期间，由于完全在线微积分讲座，学生的成绩并不理想。该研究的主要目标是了解混合学习和基于新冠肺炎 的微积分课程如何影响学生在线学习的成绩。本研究的人群包括来自安

© 2022 by the authors. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (http://creativecommons.org/licenses/by/4.0/).

达拉斯大学的 224 名本科生，他们在 2021 学年的奇数学期就读微积分课程，分为四个班级：A1、A2、A3 和 A4，而研究样本由两个班级组成（A1 和 A4）随机抽取 114 名学生。实验班和对照班共开课七次，实验班采用混合学习和地理坐标辅助，对照班完全在线学习。本研究采用四题期中测试作为工具。该测试基于微积分课程的学习目标，并已被数学和数学教育专家宣布有效。研究结果表明，使用混合学习和地理坐标 教授和学习微积分对成绩产生积极影响。更多的学生协作、更多以学生为中心的知识增长和参与、学习和教学的更大灵活性以及一系列均衡的学习资源和方法都是混合式学习和地理坐标 的好处。男女学生的微积分成绩存在显着差异，在线学习中性别与学习因素对微积分成绩没有交互作用。

关键词：混合学习，微积分成就，新冠肺炎大流行，性别，地理坐标。

1. Introduction

Calculus is an area of mathematics with numerous applications in science and technology, making it extremely important to master. Functions, rates of change, limit, continuity, derivative, slope, integral, and differential equations are among the essential topics in calculus [1–6]. According to [2], the concept of limit is the most fundamental notion. This is because of its relationship with several other essential ideas in calculus, such as derivatives, integrals, and continuity. The concept of slope is commonly used in science, such as physics and chemistry, to explain the velocity of an object traveling with constant acceleration, the ideal gas law, and the Arrhenius equation [4]. Meanwhile, calculus principles such as piecewise linear, quadratic, cubic, exponential, sine, cosine, linear, and polynomial functions; rates of change, derivative, and integral are commonly employed in engineering [7]. As a result, calculus material must cover all of these essential topics, with the amount of detail and applicability tailored to the needs of each science and engineering department.

Until early March 2020, calculus lectures at most colleges, especially in West Sumatera, were held face-to-face but suddenly switched to online learning because of the coronavirus disease. Coronavirus disease, known as COVID-19 by the WHO, has been designated a world pandemic [8]. Today, COVID-19 has spread worldwide and has affected our lives, including education [9, 10]. This pandemic necessitates a massive learning model policy, and the epidemic is a severe problem for the educational system [11]. All of us should keep lectures in the pandemic period well while keeping COVID-19 from spreading more widely. E-Learning or online learning is a wise choice for courses during the pandemic [12]. This is possible because universities in Indonesia are supported with internet infrastructure.

Following up on the COVID-19 pandemic, the Government of Indonesia, in this case, the Ministry of Education, Culture, Research, and Technology, gave instructions to universities so that face-to-face lectures are directly eliminated and replaced with lectures by using the internet or online learning networks. Many forms of online learning platforms can be used to achieve learning objectives, for example, WhatsApp [13], live-video conferencing [14], and E-Learning prepared by the university through the campus website [15]. Given the absence of guarantees that pandemics such as COVID-19 and the like will not happen again, E-learning-based lectures will remain the top choice in the future [16].

The experiences of authors who carried out online learning at Padang State University, Andalas University, and Padang State Polytechnic during the COVID-19 pandemic, where lectures are completely delivered online through the university learning management system, most students who learn through online learning struggle hard to master each material, but they have difficulty mastering it well, as happened in calculus learning. This hinders the achievement of learning objectives, especially those concerning the mastery of the material by students. This is evidenced by the final calculus exam of Andalas University students' average of 50.45, which is much lower than the average before the COVID-19 pandemic. Many researchers have report that most students have trouble grasping calculus in offline learning. Among the topics that students find challenging were: limits [17–19], derivatives [5, 20–22], functions [1, 3], rate of change [23–25], and integral [4, 26, 27]. They then proposed various learning strategies to address this, such as the cognitive orientation of calculus tasks [28], multirepresentations of mathematics concepts (Hoban, 2018), formal definition preceded by an informal definition [19], and using diagrams to represent relationships between quantities [5].

What factors contribute to low-calculus academic accomplishment at Andalas University, particularly during the COVID-19 pandemic? Based on an interview with ten students who received the lowest grade on the final exams, it was discovered that: 1) the presentation of mathematical concepts and theorems is challenging to understand; 2) there are insufficient examples related to mathematical concepts (example and counter-example); 3) there are bad examples related to the use of theorem; 4) Even if it has been read many times, some mathematical principles are difficult to grasp; 5) Students do not know how to check the accuracy of the assignment answers; 6) Students have trouble approaching colleagues and lecturers for assistance; 7) College assignments are excessive, causing time to be spent on tasks rather than understanding lecture content; 8) Inadequate examples of calculus application in daily life, particularly in modeling mathematical problem into mathematical equations.

The interview results revealed two main problems in calculus learning that is entirely online through the website (without any face-to-face, both offline or online). First, there are several concepts and theorems in calculus that are difficult for students to understand without the help of explanations from lecturers. Second, Students have difficulty checking the correctness of the answers to the tasks performed by the students. Because offline learning is not possible during the COVID-19 epidemic, to tackle the first problem, lecturers can use blended learning-based calculus learning. Namely, website-based lectures accompanied by face-to-face online through Zoom meeting applications, and lecturers can use GeoGebra math applications to visualize concepts and theorems in calculus and can be used by students to check the correctness of the answers to tasks they create, which are two up-and-coming solutions to try. GeoGebra offers plenty more applets for calculus lectures compared to other math applications.

Instructional methods incorporating offline and online learning have been termed blended learning (BL) [29]. It is a chance to combine technical advancements and innovations delivered through online learning with the engagement and participation given by the best traditional education [30, 31]. The benefits of BL include: instructors and students communicating more effectively, increased student collaboration effectiveness, increased student-centered knowledge development and engagement, increased learning and teaching flexibility, and a well-balanced mix of learning tools and approaches [32, 33]. BL has a more favorable effect than completely online or traditional face-to-face situations [34], including enhanced learning results and attitudes toward mathematics (statistics) [35]. As a result, BL holds a lot of promise for teaching calculus during the COVID-19 pandemic. Unfortunately, the use of BL necessitates significant support for information and communication technology (ICT).

ICT has become one of the most significant factors for improving teaching and learning [36, 37], with mathematics teaching and learning being the most important [38]. As a result, to perform effectively in modern technology-driven schools, students are expected to gain various skills [39], and the use of ICT in learning give the opportunity for students to explore their previous knowledge related to the topics they are studying [40]. GeoGebra, as an ICT tool, is one of the most recent instructional tools that have piqued the interest of researchers and math educators due to its potential to transform mathematics teaching and learning [41], from primary school to university level [42]. It promotes mathematical experiments and discoveries both in the classroom and at home and can be used for active and problem-oriented instruction [43]. It is free software [44] with various GeoGebra applets accessible at www. Geogebra. Org. Millions of people communicate daily, whether online or offline [45], and this can help pupils enhance their mathematical thinking [46–48]. Given the benefits of using GeoGebra in mathematics learning, especially to visualize concepts in calculus, combining BL with GeoGebra will make it easier for lecturers to teach and students to learn calculus.However, due to the disparities in attitudes between female and male students concerning using ICT in the classroom, we must ensure that GeoGebra is beneficial to all students.

Gender differences in mathematics achievement and attitudes have been widely researched. Girls do poorly in mathematics than males in face-to-face learning or offline learning and have more unfavorable attitudes toward mathematics [49, 50]. Because blended learning requires the use of computers, men are more likely than women to use ICT in their learning [51]. Some differences are observed in e-learning among men and women [52]. This study answers the following research question: (1) Are students who learn calculus through blended learning more successful than those who learn entirely online? (2) Is there a difference in calculus achievement between males and females? (3) Is there an interaction between gender and learning factors toward calculus achievement?

2. Methods

This type of research design was pseudo-experimental research using a posttest-only control group design. The population of this study consisted of 224 undergraduate students from Andalas University who were enrolled in calculus courses in the 2021 academic year's odd semesters, divided into four classes: A1, A2, A3, and A4, whereas the research sample consisted of two classes with 114 students randomly selected, namely class A1 as an experimental class and class A4 as a control class.

The experimental class used blended learning and GeoGebra, with three times as much asynchronous fully online learning and four times as much face-to-face learning via the Zoom Meeting platform, compared to seven times as much asynchronous, fully online learning in the control class, both classes using the same teaching materials and being taught by the same of lecturer.However, in the experimental class, lectures were enriched using GeoGebra to visualize concepts and properties in calculus and to check the correctness of students' solutions in solving exercises in face-to-face learning via the Zoom Meeting platform. For example, when explaining how to create a graph of a function, the lecturer first discusses how to draw a graph function in the following manner. First, get the coordinates of a few points that satisfy the equation and write them down in a table.Plot these points on a Cartesian coordinate in the second step. Connect the points with a smooth curve in the third step. Furthermore, lecturers and students use the process to draw a function graph; moreover, the graph of the function is compared to the chart created using the GeoGebra software. At Andalas University, asynchronous, fully online calculus courses are delivered using "ilearn," a Moodle-based learning platform that enables educators to arrange teaching materials and provide online lessons. Lecturers can also create student-centered activities such as questionnaires, forums, and assessments, which can be scored online when students take quizzes, midterms, and finals.

The instrument used in this study was a four-question midterm test, as presented in Table 1. The test is based on the learning objectives of calculus courses and has been declared valid by experts in mathematics and mathematics education. Based on the truth level of the answer, each student's answer is given a score of 0, 1, 2, 3, or 4. The Midterms in both classes were held at the eighth meeting.

Table 1 The four-question midterm test for calculus

1.	Solve the inequality $\lvert x\rvert + \lvert x+1\rvert < 2$
2.	Given $f(x) = \begin{cases} x^2, x < 2 \\ -x, x \geq 2 \end{cases}$, sketch the graphs of $f + g$
3.	Given $f(x) = \sqrt{1-x^2}$, find $\lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$
4.	Given $f(x) = \begin{cases} 1, x \leq 1 \\ ax+b, 1 < x < 3 \\ -1, x \geq 3 \end{cases}$, find a and b so that $f(x)$ at 1 and 3

The first, second, and third research questions were answered using Analysis of Variance (ANOVA) using SPSS 17.0 at a significant level of 5%, followed by a normality and homogeneity test.

3. Results and Discussion

Data on students' achievement in calculus were obtained from the midterms of the courses, as shown in Tables 2 and 3.

Table 2 The descriptive statistics of students' calculus achievement in the experiment and control

Class	Number of Students	Mean	Stand. Deviations
Experiment	60	66.9167	13.34330
Control	54	60.4630	13.29167

Table 3 Male and female students' calculus achievement descriptive statistics

Gender	Number of Students	Mean	Stand. Deviations
Male	33	68.1818	10.73969
Female	81	62.0988	14.35845

Table 2 shows that the average calculus achievement for the experimental class was higher than the control class (66.9167 > 60.4630), but his performance was less evenly distributed (13.34330 > 13.29167). Table 3 shows that the average calculus achievement for male students was higher than that for female students (68.1818 > 62.0988), and their performance is evenly distributed (10.73969 < 14.35845).

To determine if the difference shown in Table 2 and Table 3 is significant, an ANOVA was performed by first performing a test of normality and homogeneity, as presented in Tables 4 and 5.

Table 4 Normality test with Shapiro-Wilk for students' achievement in calculus

Class	K-S Statistic	df	Sig.	Decision
Experiment	.978	60	.365	The score was normal (.365 > 0.05)
Control	.964	54	.100	The score was normal (.100 > 0.05)

Table 5 The homogeneity of variance Levene's test for experiment and control class

Levene-statistic	df1	df2	Sig.	Decision
.000	1	112	.991	The variance score was equal (.991 > 0.05)

Since both data groups have a normal distribution and homogeneous variance, an ANOVA was performed. Table 6 summarizes the findings.

Table 6 ANOVA results summary for students' achievement in calculus

Source	Sum of Squares	df	Mean Square	F	Sig.
Method	646.399	1	646.399	3.761	.045
Gender	867.120	1	867.120	5.046	.027
Method * Gender	144.384	1	144.384	.840	.361
Error	18904.380	110	171.858		
Total	485950.000	114			

There is a significant difference between the experimental and control classes, as seen in Table 6 (.045 < 5%), likewise with males and females (0.027 < 5%) in calculus performance. However, there is no interaction between gender and learning factors toward calculus achievement (.361 > 5%).

This research implies an expanding corpus of research on undergraduate student accomplishment by examining the impact of blended learning and GeoGebra in online learning on students' calculus achievement.Why blended learning and GeoGebra can promote student achievement in online learning? Students are more engaged in constructing their knowledge in blended learning than offline learning. They receive guidance in building their expertise from lecturers face-to-face via a Zoom Meeting. Finally, the usage of GeoGebra, particularly Calculus Applets, in teaching and learning Calculus makes lecturers and students can learn and teach calculus more easily.

Experts in the literature suggest at least five points to help students understand calculus: 1) According to [53], mathematical concepts should be represented in multiple representations.When possible, use numerical, algebraic, visual, and verbal representations to help students understand the links between different representations and acquire more profound and comprehensive knowledge. A function concept, for example, can be presented as a graphic, table, graph, word problem, or algebraic formula [1]; 2) A constructivist approach to problem-centered learning/active learning appears to be an effective technique to teaching and learn calculus [54]; 3) GeoGebra can help students learn mathematical concepts, reason, construct and explore knowledge, solve issues, and generate new information [55]. It also aids pupils in better visualizing mathematical topics [56]; 4) Before a formal definition of the notion using mathematical symbols, explanations, and visuals using various representations should be provided [6]; 5) Using challenging mathematical activities to assist kids in learning [28, 57]. All five of these points can be addressed through blended learning and GeoGebra-based learning.

Mathematical learning relies heavily on multiple representations, as they aid students in making sense of mathematical tasks and concepts and facilitating their learning process. They aid students in managing and expressing their thoughts, as well as creating mental models of their mathematical ideas; they aid students in comprehending abstract mathematical concepts, and they aid students in analyzing mathematical problems [58–60]. Multiple representation strategies improve mathematical accomplishment, particularly in sub-dimensions such as verbal problem solving, reading graphs, interpreting graphs, reading tables, interpreting tables, solving equations, and creating equations. [61]. As a result, lecturers should be aware of how to employ various representations when teaching a particular topic in calculus and how to use some teaching tactics compatible with learning processes with many representations. Because of the numerous representations, it will be feasible to satisfy the students' varying learning preferences. Here is where GeoGebra comes in, assisting in representing mathematical concepts, particularly calculus, in various forms.

Regardless of the topic or style of the information delivery method, student engagement in active learning is critical to effective learning, and active learning can occur in a classroom, blended learning, or fully online setting. However, there are several ways for adopting and implementing active learning in non-face-to-face settings, including well-designed interactions, group work, and creating a collaborative atmosphere that supports and fosters collaborative learning. Active learning should be woven throughout the core components of an online or hybrid course, such as discussions, assignments, and evaluations, to encourage high levels of student participation [62]. Students engaged in blended learning were more motivated to learn [63], which has consequences for student learning outcomes in the cognitive, affective, and psychomotor domains [64]. Compared to fully online learning, the usage of Zoom Meeting in the blended learning setting in online education allows for more successful discussions between students and lecturers.

Why do male students perform better than female students in calculus in online lectures? Different types of ICT in lectures calculus in online learning are especially beneficial for male students since males are more likely than females to use computers and new media in their learning [51].

4. Conclusion

Based on an analysis of students' calculus achievement using ANOVA, the following conclusions can be drawn. (1) Calculus courses based on blended learning and GeoGebra can improve student achievement significantly. (2) There was a significant difference in calculus achievement between male and female students in online learning. (3) in online learning, there was no interaction between gender and learning factors toward calculus achievement.

Blended learning refers to instructional strategies that combine offline and online learning (BL).Here is an opportunity to combine the technical breakthroughs and advancements made possible by online learning with the participation and engagement offered by the very finest traditional education. The advantages of BL include improved communication between teachers and students, improved student collaboration, more student-centered knowledge growth and engagement, increased flexibility in learning and teaching, and a well-balanced selection of learning tools and methodologies. Compared to fully online or conventional face-to-face settings, BL has a stronger positive impact on learning outcomes and attitudes about mathematics. As a result, BL has a lot of potential for using during the COVID-19 pandemic to teach calculus.

References

[1] ALAJMI A. H., & AL-KANDARI M. M. Calculus 1 college students' concept of function. *International Journal of Mathematical Education in Science and Technology*, 2022, 53(2): 251-268. https://doi.org/10.1080/0020739X.2020.1798526

[2] ALIUSTAOĞLU F., & TUNA A. Examining the pedagogical content knowledge of prospective mathematics teachers on the subject of limits. *International Journal of Mathematical Education in Science and Technology*, 2021, 52(6): 833-856. https://doi.org/10.1080/0020739X.2019.1703148

[3] AYALON M., & WILKIE K. Students' identification and expression of relations between variables in linear functions tasks in three curriculum contexts. *Mathematical Thinking and Learning*, 2020, 22(1): 1-22. https://doi.org/10.1080/10986065.2019.1619221

[4] HOBAN R. A. A resource for introducing students to the integral concept. *International Journal of Mathematical Education in Science and Technology*, 2019, 50(4): 603-616. https://doi.org/10.1080/0020739X.2018.1480809

[5] MKHATSHWA T. P. Calculus students' quantitative reasoning in the context of solving related rates of change problems. *Mathematical Thinking and Learning*, 2020, 22(2): 139-161. https://doi.org/10.1080/10986065.2019.1658055

[6] WEIGAND H. G. A discrete approach to the concept of derivative. *Zentralblatt für Didaktik der Mathematik - Mathematics Education*, 2014, 46(4): 603–619. https://doi.org/10.1007/s11858-014-0595-x

[7] HORWITZ A., & EBRAHIMPOUR A. Engineering applications in differential and integral calculus. *International Journal of Engineering Education*, 2002, 18(1): 78-88. https://www.ijee.ie/articles/Vol18-1/Ijee1262.pdf

[8] KHATRI P., S.R. SINGH, N.K. BELANI, Y.L. YEONG, R. LOHAN, Y.W. LIM, and TEO W.Z.Y. YouTube as source of information on 2019 novel coronavirus outbreak: a cross sectional study of English and Mandarin content. *Travel Medicine and Infectious Disease*, 2020, 35: 101636. https://doi.org/10.1016/j.Tmaid.2020.101636

[9] ALOMYAN H. The impact of distance learning on the psychology and learning of university students during the covid-19 pandemic. *International Journal of Instruction*, 2021, 14(4): 585-606. https://doi.org/10.29333/iji.2021.14434a

[10] MANTASIAH R., YUSRI, SINRING A., and ARYANI F. Assessing verbal positive reinforcement of teachers during school from home in the covid-19 pandemic era. *International Journal of Instruction*, 2021, 14(2): 1037-1050. https://doi.org/10.29333/iji.2021.14259a

[11] DANIEL S. J. Education and the COVID-19 pandemic. *Prospects*, 2020, 49(1–2): 91–96. https://doi.org/10.1007/s11125-020-09464-3

[12] MAKRUF I., RIFA'I A. A., and TRIANA Y. Moodle-based online learning management in higher education. *International Journal of Instruction*, 2022, 15(1): 135-152. https://doi.org/10.29333/iji.2022.1518a

[13] VERAWARDINA U., ASNUR L., LUBIS A. L., HENDRIYANI Y., RAMADHANI D., DEWI I. P., DARNI R., BETRI T. J., SUSANTI W., and SRIWAHYUNI T. Reviewing Online Learning Facing the COVID-19 Outbreak. *Journal of Talent Development and Excellence*, 2020, 12: 385-392. https://www.semanticscholar.org/paper/Reviewing-Online-Learning-Facing-the-Covid-19-Verawardina-Asnur/f28e636a2aa51cd55404e202518a8bf1293a7b4d

[14] SCHNEIDER S. L., & COUNCIL M. L. Distance learning in the era of COVID-19. *Archives of Dermatological Research*, 2021, 313(5): 389–390. https://doi.org/10.1007/s00403-020-02088-9

[15] JOHN E. S. Effect of COVID-19 on the Performance of Grade 12 Students: Implications for STEM Education. *Eurasia Journal of Mathematics, Science and Technology Education*, 2020, 16(7): em1851. https://doi.org/10.29333/ejmste/7893

[16] JONES K., & SHARMA R. S. On Reimagining a Future for Online Learning in the Post-COVID Era. *SSRN Electronic Journal*, 2020, https://doi.org/10.2139/ssrn.3578310

[17] CETIN N. The performance of undergraduate students in the limit concept. *International Journal of Mathematical Education in Science and Technology*, 2009, 40(3), 323-330. https://doi.org/10.1080/00207390802568119

[18] SWINYARD C. Reinventing the formal definition of limit: The case of Amy and Mike. *Journal of Mathematical Behavior*, 2011, 30(2), 93-114. https://doi.org/10.1016/j.jmathb.2011.01.001

[19] ADIREDJA A. P. Students' struggles with temporal order in the limit definition: uncovering resources using knowledge in pieces. *International Journal of Mathematical Education in Science and Technology*, 2021, 52(9): 1295-1321. https://doi.org/10.1080/0020739X.2020.1754477

[20] MUZANGWA J., & CHIFAMBA P. Analysis of errors and misconceptions in the learning of calculus by undergraduate students. *Acta Didactica Napocensia*, 2012, 5(2): 1-10.

[21] FUENTEALBA C., BADILLO E., SÁNCHEZ-MATAMOROS G., and CÁRCAMO A. The understanding of the derivative concept in higher education. *Eurasia Journal of Mathematics, Science and Technology Education*, 2019, 15(2): em1662. https://doi.org/10.29333/ejmste/100640

[22] HAMID S. M. Online Digital Platforms during Covid-19 in EFL Classes: Visual Impairment Student' Perception. *English Teaching, Learning, and Research Journal*, 2020, 6(2): 328. https://doi.org/10.24252/eternal.v62.2020. A10

[23] BYERLEY C., & THOMPSON P. W. Secondary mathematics teachers' meanings for measure, slope, and rate of change. *Journal of Mathematical Behavior*, 2017, 48: 168-193. https://doi.org/10.1016/j.jmathb.2017.09.003

[24] ZAHNER W., MILBOURNE H., and WYNN L. Developing and refining a framework for mathematical and linguistic complexity in tasks related to rates of change. *Journal of Mathematical Behavior*, 2018, 52: 21-36. https://doi.org/10.1016/j.jmathb.2018.04.003

[25] DOLORES-FLORES C., RIVERA-LÓPEZ M. I., and GARCÍA-GARCÍA J. Exploring mathematical connections of pre-university students through tasks involving rates of change. *International Journal of Mathematical Education in Science and Technology*, 2019, 50(3): 369-389. https://doi.org/10.1080/0020739X.2018.1507050

[26] FERRER F. P. Investigating Students' Learning Difficulties in Integral Calculus. *PEOPLE: International*

Journal of Social Sciences, 2016, 2(1): 310–324. https://doi.org/10.20319/pijss.2016.S21.310324
[27] NURSYAHIDAH F., & ALBAB I. U. Investigating student difficulties on integral calculus based on critical thinking aspects. *Jurnal Riset Pendidikan Matematika*, 2017, 4(2): 211-218. https://doi.org/10.21831/jrpm.v4i2.15507
[28] WHITE N., & MESA V. Describing cognitive orientation of Calculus I tasks across different types of coursework. *Zentralblatt für Didaktik der Mathematik - Mathematics Education*, 2014, 46(4): 675–690. https://doi.org/10.1007/s11858-014-0588-9
[29] HARAHAP F., NASUTION N. E. A., and MANURUNG B. The effect of blended learning on student's learning achievement and science process skills in plant tissue culture course. *International Journal of Instruction*, 2019, 12(1): 521-538. https://doi.org/10.29333/iji.2019.12134a
[30] SUMARMI, BACHRI S., IRAWAN L. Y., and ALIMAN M. E-module in blended learning: Its impact on students' disaster preparedness and innovation in developing learning media. *International Journal of Instruction*, 2021, 14(4): 187-208. https://doi.org/10.29333/iji.2021.14412a
[31] HRASTINSKI S. What Do We Mean by Blended Learning? *Tech Trends*, 2019, 63(5): 564–569. https://doi.org/10.1007/s11528-019-00375-5
[32] GRAHAM C. R., WOODFIELD W., and HARRISON J. B. A framework for institutional adoption and implementation of blended learning in higher education. *Internet and Higher Education*, 2013, 18: 4-14. https://doi.org/10.1016/j.Iheduc.2012.09.003
[33] GARRISON D. R., & KANUKA H. Blended learning: Uncovering its transformative potential in higher education. *Internet and Higher Education*, 2004, 7(2): 95-105. https://doi.org/10.1016/j.Iheduc.2004.02.001
[34] DZIUBAN C., GRAHAM C. R., MOSKAL P. D., NORBERG A., and SICILIA N. Blended learning: the new normal and emerging technologies. *International Journal of Educational Technology in Higher Education*, 2018, 15(1): 3. https://doi.org/10.1186/s41239-017-0087-5
[35] JAZAYERI M., & LI X. Examining the effect of blended instructional method on students' grades in an introductory statistics course. *International Journal of Mathematical Education in Science and Technology*, 2021, 52(8): 1240-1249. https://doi.org/10.1080/0020739X.2020.1775319
[36] SYARIFUDDIN H., & ARNAWA M. I. M. Development of Electronic Learning Tools to Improve the Quality of Elementary Linear Algebra Course. Proceedings of the University of Muhammadiyah Malang's 1st International Conference of Mathematics Education, Malang, 2018. https://doi.org/10.2991/incomed-17.2018.10
[37] YEOP M. A., YAAKOB M. F. M., WONG K. T., DON Y., and ZAIN F. M. Implementation of ICT policy (blended learning approach): Investigating factors of behavioural intention and use behaviour. *International Journal of Instruction*, 2019, 12(1): 767-782. https://doi.org/10.29333/iji.2019.12149a
[38] TAJUDIN N. M., ADNAN M., SUHAIMI N. A., and PUTEH M. Mathematical Learning Transformation through Cybergogy Approach towards Future Ready Curriculum. *Review of International Geographical Education Online*, 2021, 11(4). https://doi.org/10.33403/rigeo.8006804
[39] MUKAMBA E. & MAKAMURE C. Integration of GeoGebra in Teaching and Learning Geometric Transformations at Ordinary Level in Zimbabwe. *Contemporary Mathematics and Science Education*, 2020, 1(1), ep20001. https://doi.org/10.30935/conmaths/8431
[40] SYARIFUDDIN H., & ATWEH B. The Use of Activity, Classroom Discussion, and Exercise (ACE) Teaching Cycle for Improving Students' Engagement in Learning Elementary Linear Algebra. *European Journal of Science and Mathematics Education*, 2022, 10(1): 104-138. https://doi.org/10.30935/SCIMATH/11405
[41] BELGHEIS S., & KAMALLUDEEN R. The Intention to Use GeoGebra in the Teaching of Mathematics among Malaysian Teachers. *Malaysian Online Journal of Educational Technology*, 2018, 6(1): 109-115. https://files.eric.ed.gov/fulltext/EJ1165486.pdf
[42] UWURUKUNDO M. S., MANIRAHO J. F., and TUSIIME M. GeoGebra integration and effectiveness in the teaching and learning of mathematics in secondary schools: A review of literature. *African Journal of Educational Studies in Mathematics and Sciences*, 2020, 16(1): 1-13. https://doi.org/10.4314/ajesms.v16i1.1
[43] MAJEREK D. Application of Geogebra For Teaching Mathematics. *Advances in Science and Technology Research Journal*, 2014, 8: 51–54. https://doi.org/10.12913/22998624/567
[44] YATIM S. S. K. M., SALEH S., ZULNAIDI H., YEW W. T., and YATIM S. A. M. Effects of brain-based teaching approach integrated with geogebra (b-geo module) on students conceptual understanding. *International Journal of Instruction*, 2022, 15(1): 327-346. https://doi.org/10.29333/iji.2022.15119a
[45] CHALAUNE B. B., & SUBEDI A. Effectiveness of GeoGebra in teaching school mathematics. *Contemporary Research: An Interdisciplinary Academic Journal*, 2020, 4(1): 46–58. https://doi.org/10.3126/craiaj.v4i1.32729
[46] SEVIMLI E. Do calculus students demand technology integration into learning environment? case of instructional differences. *International Journal of Educational Technology in Higher Education*, 2016, 13(1): 37. https://doi.org/10.1186/s41239-016-0038-6
[47] FUNG C. H., & POON K. K. Can dynamic activities boost mathematics understanding and metacognition? A case study on the limit of rational functions. *International Journal of Mathematical Education in Science and Technology*, 2021, 52(8): 1225-1239. https://doi.org/10.1080/0020739X.2020.1749905
[48] BIRGIN O., & ACAR H. The effect of computer-supported collaborative learning using GeoGebra software on 11th grade students' mathematics achievement in exponential and logarithmic functions. *International Journal of Mathematical Education in Science and Technology*, 2020, 4: 872-889. https://doi.org/10.1080/0020739X.2020.1788186
[49] BAKER D. P., & JONES D. P. Creating Gender Equality: Cross-national Gender Stratification and Mathematical Performance. *Sociology of Education*, 1993, 66(2): 91-103. https://doi.org/10.2307/2112795
[50] ECCLES J. S. Understanding women's educational and occupational choices: Applying the Eccles et al. model of achievement-related choices. *Psychology of Women Quarterly*, 1994, 18(4): 585–609. https://doi.org/10.1111/j.1471-6402.1994.Tb01049.x
[51] DORMAN S. Technology and the gender gap. *Journal*

of School Health, 1998, 68(4): 165-166. https://doi.org/10.1111/j.1746-1561.1998.tb06338.x
[52] CUADRADO-GARCÍA M., RUIZ-MOLINA M. E., and MONTORO-PONS J. D. Are there gender differences in e-learning use and assessment? Evidence from an interuniversity online project in Europe. *Procedia - Social and Behavioral Sciences*, 2010, 2(2): 367-371. https://doi.org/10.1016/j.Sbspro.2010.03.027
[53] HACIOMEROGLU E. S., ASPINWALL L., and PRESMEG N. C. Contrasting cases of calculus students' understanding of derivative graphs. *Mathematical Thinking and Learning*, 2010, 12(2): 152-176. https://doi.org/10.1080/10986060903480300
[54] DENBEL D. G. Students' Misconceptions of the Limit Concept in a First Calculus Course. *Journal of Education and Practice*, 2014, 5(34): 24-40. https://www.iiste.org/Journals/index.php/JEP/article/view/17236/17685
[55] SARIYASA J. S., & ARDANA I. M. Effect of GeoGebra-aided REACT strategy on understanding of geometry concepts. *International Journal of Instruction*, 2018, 11(4): 325-336. https://doi.org/10.12973/iji.2018.11421a
[56] OKTAVIYANTHI R., & SUPRIANI Y. Utilizing microsoft mathematics in teaching and learning calculus. *Journal on Mathematics Education*, 2015, 6(1): 63-76. https://doi.org/10.22342/jme.6.1.1902.63-76
[57] JUNGIC V. Making calculus relevant: final exam in the time of COVID-19. *International Journal of Mathematical Education in Science and Technology*, 2021, 52(4): 609-621. https://doi.org/10.1080/0020739X.2020.1775903
[58] SAMSUDDIN A. F., & RETNAWATI H. Mathematical representation: The roles, challenges and implication on instruction. *Journal of Physics: Conference Series*, 2018, 1097: 012152. https://doi.org/10.1088/1742-6596/1097/1/012152
[59] NURRAHMAWATI, SA'DIJAH C., SUDIRMAN, MUKSAR M., AS'ARI A. R., and NUSANTARA T. Pre-service mathemathics teachers' preferences in Using multiple representation of word problem solving. *International Journal of Insight for Mathematics Teaching*, 2018, 01(2): 141-150. https://www.researchgate.net/publication/339399951_PRE-SERVICE_MATHEMATHICS_TEACHERS'_PREFERENCES_IN_USING_MULTIPLE_REPRESENTATION_OF_WORD_PROBLEM_SOLVING
[60] KUSUMANINGSIH W., DARHIM, HERMAN T., and TURMUDI. Improvement algebraic thinking ability using multiple representation strategy on realistic mathematics education. *Journal on Mathematics Education*, 2018, 9(2): 281-290. https://doi.org/10.22342/jme.9.2.5404.281-290
[61] ÇETIN H., & AYDIN S. The Effect of Multiple Representation Based Instruction on Mathematical Achievement: A Meta-Analysis. *International Journal of Educational Research Review*, 2020, 5(1): 26-36. https://doi.org/10.24331/ijere.647531
[62] KHAN A., EGBUE O., PALKIE B., and MADDEN J. Active learning: Engaging students to maximize learning in an online course. *Electronic Journal of e-Learning*, 2017, 15(2): 107-115. https://www.researchgate.net/publication/317214355_Active_learning_Engaging_students_to_maximize_learning_in_an_online_course
[63] BAHRI A., IDRIS I. S., MUIS H., ARIFUDDIN M., and FIKRI M. J. N. Blended Learning Integrated with Innovative Learning Strategy to Improve Self-Regulated Learning. *International Journal of Instruction*, 2020, 14(1): 779-794. https://doi.org/10.29333/IJI.2021.14147A
[64] ARIAWAN I. P. W., & DIVAYANA D. G. H. Design of blended learning based on tri kaya parisudha using kelase platform in realizing hybrid-superitem learning in mathematics lessons. *International Journal of Instruction*, 2020, 13(3): 679-698. https://doi.org/10.29333/iji.2020.13346a

参考文:

[1] ALAJMI A. H., 和 AL-KANDARI M. M. 微积分 1 大学生的函数概念。国际科学技术数学教育杂志, 2022, 53(2): 第 251-268 页. https://doi.org/10.1080/0020739X.2020.1798526
[2] ALIUSTAOĞLU F., 和 TUNA A. 检查未来数学教师对极限主题的教学内容知识。国际科学技术数学教育杂志, 2021, 52(6): 第 833-856 页. https://doi.org/10.1080/0020739X.2019.1703148
[3] AYALON M., 和 WILKIE K. 学生在三种课程背景下识别和表达线性函数任务中变量之间的关系。数学思维与学习, 2020, 22(1): 第 1-22 页. https://doi.org/10.1080/10986065.2019.1619221
[4] HOBAN R. A. 向学生介绍积分概念的资源。国际科技数学教育杂志, 2019, 50(4): 第 603-616 页. https://doi.org/10.1080/0020739X.2018.1480809
[5] MKHATSHWA T. P. 微积分学生在解决相关变化率问题的背景下的定量推理。数学思维与学习, 2020, 22(2): 第 139-161 页. https://doi.org/10.1080/10986065.2019.1658055
[6] WEIGAND H. G. 导数概念的离散方法。中央数学教学杂志 - 数学教育, 2014, 46(4): 第 603–619 页. https://doi.org/10.1007/s11858-014-0595-x
[7] HORWITZ A., 和 EBRAHIMPOUR A. 微分学和积分学中的工程应用。国际工程教育杂志, 2002, 18(1): 第 78-88 页. https://www.ijee.ie/articles/Vol18-1/Ijee1262.pdf
[8] KHATRI P., S.R. SINGH, N.K. BELANI, Y.L. YEONG, R. LOHAN, Y.W. LIM, 和 TEO W.Z.Y. 友突巴作为 2019 年新型冠状病毒爆发的信息来源：英语和普通话内容的横断面研究。旅游医学与传染病, 2020, 35: 第 101636 条. https://doi.org/10.1016/j.Tmaid.2020.101636
[9] ALOMYAN H. 新冠肺炎大流行期间远程学习对大学生心理和学习的影响。国际教学杂志, 2021, 14(4): 第 585-606 页. https://doi.org/10.29333/iji.2021.14434a
[10] MANTASIAH R., YUSRI, SINRING A., 和 ARYANI

F. 在新冠肺炎大流行时代评估教师在家上学期间的口头积极强化。国际教学杂志, 2021, 14(2): 第 1037-1050 页. https://doi.org/10.29333/iji.2021.14259a

[11] DANIEL S. J. 教育和新冠肺炎 大流行。前景, 2020, 49(1–2): 第 91–96 页. https://doi.org/10.1007/s11125-020-09464-3

[12] MAKRUF I., RIFA'I A. A., 和 TRIANA Y. 高等教育中基于摩德丽的在线学习管理。国际教学杂志, 2022, 15(1): 第 135-152 页. https://doi.org/10.29333/iji.2022.1518a

[13] VERAWARDINA U., ASNUR L., LUBIS A. L., HENDRIYANI Y., RAMADHANI D., DEWI I. P., DARNI R., BETRI T. J., SUSANTI W., 和 SRIWAHYUNI T. 回顾面对新冠肺炎 爆发的在线学习。人才发展与卓越杂志, 2020, 12: 第 385-392 页. https://www.semanticscholar.org/paper/Reviewing-Online-Learning-Facing-the-Covid-19-Verawardina-Asnur/f28e636a2aa51cd55404e202518a8bf1293a7b4d

[14] SCHNEIDER S. L., 和 COUNCIL M. L. 新冠肺炎时代的远程学习。皮肤病学研究档案, 2021, 313(5): 第 389–390 页. https://doi.org/10.1007/s00403-020-02088-9

[15] JOHN E. S. 新冠肺炎对 12 年级学生表现的影响：对科学、技术、工程和数学教育的影响。欧亚数学科学与技术教育杂志, 2020, 16(7): 文章 em1851. https://doi.org/10.29333/ejmste/7893

[16] JONES K., 和 SHARMA R. S. 重新构想后冠状病毒时代在线学习的未来。社会科学研究网络电子期刊, 2020, https://doi.org/10.2139/ssrn.3578310

[17] CETIN N. 大学生极限概念的表现. 国际科技数学教育杂志, 2009, 40(3), 第 323-330 页. https://doi.org/10.1080/00207390802568119

[18] SWINYARD C. 重塑极限的正式定义：艾米和麦克风的案例。数学行为杂志, 2011, 30(2), 第 93-114 页. https://doi.org/10.1016/j.jmathb.2011.01.001

[19] ADIREDJA A. P. 学生在极限定义中与时间顺序的斗争：使用碎片化知识发现资源。国际科技数学教育杂志, 2021, 52(9): 第 1295-1321 页. https://doi.org/10.1080/0020739X.2020.1754477

[20] MUZANGWA J., 和 CHIFAMBA P. 本科生微积分学习误区与误区分析耐泼森希阿教学法, 2012, 5(2): 第 1-10 页.

[21] FUENTEALBA C., BADILLO E., SÁNCHEZ-MATAMOROS G., 和 CÁRCAMO A. 高等教育中导数概念的理解. 欧亚数学科学与技术教育杂志, 2019, 15(2): 文章时间 1662. https://doi.org/10.29333/ejmste/100640

[22] HAMID S. M. 英语课程中新冠肺炎 期间的在线数字平台：视障学生的感知。英语教学、学习和研究期刊, 2020, 6(2): 第 328 页. https://doi.org/10.24252/eternal.v62.2020. A10

[23] BYERLEY C., 和 THOMPSON P. W. 中学数学教师对测量、斜率和变化率的意义。数学行为杂志, 2017, 48: 第 168-193 页. https://doi.org/10.1016/j.jmathb.2017.09.003

[24] ZAHNER W., MILBOURNE H., 和 WYNN L. 在与变化率相关的任务中开发和改进数学和语言复杂性的框架。数学行为杂志, 2018, 52: 第 21-36 页. https://doi.org/10.1016/j.jmathb.2018.04.003

[25] DOLORES-FLORES C., RIVERA-LÓPEZ M. I., 和 GARCÍA-GARCÍA J. 通过涉及变化率的任务探索大学预科生的数学联系。国际科技数学教育杂志, 2019, 50(3): 第 369-389 页. https://doi.org/10.1080/0020739X.2018.1507050

[26] FERRER F. P. 调查学生在积分学中的学习困难。人物：国际社会科学杂志, 2016, 2(1): 第 310–324 页. https://doi.org/10.20319/pijss.2016.S21.310324

[27] NURSYAHIDAH F., 和 ALBAB I. U. 基于批判性思维方面调查学生在积分学上的困难。数学教育研究杂志, 2017, 4(2): 第 211-218 页. https://doi.org/10.21831/jrpm.v4i2.15507

[28] WHITE N., 和 MESA V. 描述不同类型课程作业中微积分 I 任务的认知取向。中央数学教学杂志-数学教育, 2014, 46(4): 第 675–690 页. https://doi.org/10.1007/s11858-014-0588-9

[29] HARAHAP F., NASUTION N. E. A., 和 MANURUNG B. 混合学习对植物组织培养课程学生学习成绩和科学过程技能的影响。国际教学杂志, 2019, 12(1): 第 521-538 页. https://doi.org/10.29333/iji.2019.12134a

[30] SUMARMI, BACHRI S., IRAWAN L. Y., 和 ALIMAN M. 混合学习中的电子模块：它对学生备灾和开发学习媒体创新的影响。国际教学杂志, 2021, 14(4): 第 187-208 页. https://doi.org/10.29333/iji.2021.14412a

[31] HRASTINSKI S. 混合式学习是什么意思？技术趋势, 2019, 63(5): 第 564–569 页. https://doi.org/10.1007/s11528-019-00375-5

[32] GRAHAM C. R., WOODFIELD W., 和 HARRISON J. B. 高等教育机构采用和实施混合学习的框架。互联网与高等教育, 2013, 18: 第 4-14 页. https://doi.org/10.1016/j.Iheduc.2012.09.003

[33] GARRISON D. R., 和 KANUKA H. 混合学习：发掘其在高等教育中的变革潜力。互联网与高等教育, 2004, 7(2): 第 95-105 页. https://doi.org/10.1016/j.Iheduc.2004.02.001

[34] DZIUBAN C., GRAHAM C. R., MOSKAL P. D., NORBERG A., 和 SICILIA N. 混合学习：新常态和新兴技术。国际高等教育教育技术期刊, 2018, 15(1): 第 3 页. https://doi.org/10.1186/s41239-017-0087-5

[35] JAZAYERI M., 和 LI X. 检查混合教学法对学生在介绍性统计课程中成绩的影响。国际科技数学教育杂志, 2021, 52(8): 第 1240-1249 页. https://doi.org/10.1080/0020739X.2020.1775319

[36] SYARIFUDDIN H., 和 ARNAWA M. I. M. 开发电子学习工具以提高初级线性代数课程的质量。玛琅穆罕默迪亚大学第一届国际数学教育会议论文集，玛琅, 2018. https://doi.org/10.2991/incomed-17.2018.10

[37] YEOP M. A., YAAKOB M. F. M., WONG K. T., DON Y., 和 ZAIN F. M. 信息通信技术政策的实施（混合学习方法）：调查行为意图和使用行为的因素。国际教学杂志, 2019, 12(1): 第 767-782 页. https://doi.org/10.29333/iji.2019.12149a

[38] TAJUDIN N. M., ADNAN M., SUHAIMI N. A., 和 PUTEH M. 通过赛博学方法实现面向未来准备课程的数学学习转型。国际地理教育在线回顾, 2021, 11(4). https://doi.org/10.33403/rigeo.8006804

[39] MUKAMBA E. 和 MAKAMURE C. 地理坐标在津巴布韦普通水平教学和学习几何变换中的整合。当代数学与科学教育, 2020 年, 1(1), 文章 ep20001. https://doi.org/10.30935/conmaths/8431

[40] SYARIFUDDIN H., 和 ATWEH B. 通过使用活动、课堂讨论和练习教学循环来提高学生学习初等线性代数的参与度。欧洲科学与数学教育杂志, 2022, 10(1): 第 104-138 页. https://doi.org/10.30935/SCIMATH/11405

[41] BELGHEIS S., 和 KAMALLUDEEN R. 马来西亚教师在数学教学中使用地理坐标的意图。马来西亚在线教育科技杂志, 2018, 6(1): 第 109-115 页. https://files.eric.ed.gov/fulltext/EJ1165486.pdf

[42] UWURUKUNDO M. S., MANIRAHO J. F., 和 TUSIIME M. 中学数学教学中的地理坐标整合和有效性：文献综述。非洲数学与科学教育研究杂志, 2020, 16(1): 第 1-13 页. https://doi.org/10.4314/ajesms.v16i1.1

[43] MAJEREK D. 地数在数学教学中的应用。科学技术研究进展, 2014, 8: 第 51–54 页. https://doi.org/10.12913/22998624/567

[44] YATIM S. S. K. M., SALEH S., ZULNAIDI H., YEW W. T., 和 YATIM S. A. M. 基于大脑的教学方法与地理地理（b-地理模块）相结合对学生概念理解的影响。国际教学杂志, 2022, 15(1): 第 327-346 页. https://doi.org/10.29333/iji.2022.15119a

[45] CHALAUNE B. B., 和 SUBEDI A. 地理坐标在学校数学教学中的有效性。当代研究：跨学科学术期刊, 2020, 4(1): 第 46–58 页. https://doi.org/10.3126/craiaj.v4i1.32729

[46] SEVIMLI E. 微积分学生是否需要将技术融入学习环境？教学差异的情况。国际高等教育教育技术杂志, 2016, 13(1): 第 37 页. https://doi.org/10.1186/s41239-016-0038-6

[47] FUNG C. H., 和 POON K. K. 动态活动能否促进数学理解和元认知？有理函数极限的个案研究。国际科技数学教育杂志, 2021, 52(8): 第 1225-1239 页. https://doi.org/10.1080/0020739X.2020.1749905

[48] BIRGIN O., 和 ACAR H. 使用地理坐标软件进行计算机支持的协作学习对 11 年级学生指数函数和对数函数数学成绩的影响。国际科技数学教育杂志, 2020, 4: 第 872-889 页. https://doi.org/10.1080/0020739X.2020.1788186

[49] BAKER D. P., 和 JONES D. P. 创造性别平等：跨国性别分层和数学成绩。教育社会学, 1993, 66(2): 第 91-103 页. https://doi.org/10.2307/2112795

[50] ECCLES J. S. 了解女性的教育和职业选择：应用埃克尔斯等人。成就相关选择模型。女性心理学季刊, 1994, 18(4): 第 585–609 页. https://doi.org/10.1111/j.1471-6402.1994.Tb01049.x

[51] DORMAN S. 技术和性别差距。学校卫生杂志, 1998, 68(4): 第 165-166 页. https://doi.org/10.1111/j.1746-1561.1998.tb06338.x

[52] CUADRADO-GARCÍA M., RUIZ-MOLINA M. E., 和 MONTORO-PONS J. D. 电子学习的使用和评估是否存在性别差异？来自欧洲大学间在线项目的证据。程序-社会和行为科学, 2010, 2(2): 第 367-371 页. https://doi.org/10.1016/j.Sbspro.2010.03.027

[53] HACIOMEROGLU E. S., ASPINWALL L., 和 PRESMEG N. C. 微积分学生对导数图理解的对比案例。数学思维与学习, 2010, 12(2): 第 152-176 页. https://doi.org/10.1080/10986060903480300

[54] DENBEL D. G. 学生对第一门微积分课程的极限概念的误解。教育与实践杂志, 2014, 5(34): 第 24-40 页. https://www.iiste.org/Journals/index.php/JEP/article/view/17236/17685

[55] SARIYASA J. S., 和 ARDANA I. M. 地理坐标辅助关联、体验、应用、合作、转移策略对某些概念的理解的影响。国际教学杂志, 2018, 11(4): 第 325-336 页. https://doi.org/10.12973/iji.2018.11421a

[56] OKTAVIYANTHI R., 和 SUPRIANI Y. 在教学和学

习微积分中利用微软数学。数学教育杂志, 2015, 6(1): 第 63-76 页. https://doi.org/10.22342/jme.6.1.1902.63-76

[57] JUNGIC V. 使微积分相关：新冠肺炎时期的期末考试。国际科技数学教育杂志, 2021, 52(4): 第 609-621 页. https://doi.org/10.1080/0020739X.2020.1775903

[58] SAMSUDDIN A. F., 和 RETNAWATI H. 数学表示：角色、挑战和对教学的影响。物理学杂志：系列会议，2018 年，1097：文章 012152. https://doi.org/10.1088/1742-6596/1097/1/012152

[59] NURRAHMAWATI, SA'DIJAH C., SUDIRMAN, MUKSAR M., AS'ARI A. R., 和 NUSANTARA T. 职前数学教师在使用多重表示法解题中的偏好。国际数学教学洞察杂志，2018, 01(2): 第 141-150 页. https://www.researchgate.net/publication/339399951_PRE-SERVICE_MATHEMATHICS_TEACHERS'_PREFERENCES_IN_USING_MULTIPLE_REPRESENTATION_OF_WORD_PROBLEM_SOLVING

[60] KUSUMANINGSIH W., DARHIM, HERMAN T., 和 TURMUDI. 在现实数学教育中使用多重表示策略提高代数思维能力。数学教育杂志, 2018, 9(2): 第 281-290 页. https://doi.org/10.22342/jme.9.2.5404.281-290

[61] ÇETIN H., 和 AYDIN S. 基于多重表示的教学对数学成绩的影响: 进步。国际教育研究评论杂志, 2020, 5(1): 第 26-36 页. https://doi.org/10.24331/ijere.647531

[62] KHAN A., EGBUE O., PALKIE B., 和 MADDEN J. 主动学习：让学生在在线课程中最大限度地学习。电子学习电子期刊，2017, 15(2): 第 107-115 页. https://www.researchgate.net/publication/317214355_Active_learning_Engaging_students_to_maximize_learning_in_an_online_course

[63] BAHRI A., IDRIS I. S., MUIS H., ARIFUDDIN M., 和 FIKRI M. J. N. 混合学习与创新学习策略相结合，以改善自主学习。国际教学杂志, 2020, 14(1): 第 779-794 页. https://doi.org/10.29333/IJI.2021.14147A

[64] ARIAWAN I. P. W., 和 DIVAYANA D. G. H. 基于富三巴利苏达的混合学习设计，使用班级平台实现数学课程中的混合超项学习。国际教学杂志, 2020, 13(3): 第 679-698 页. https://doi.org/10.29333/iji.2020.13346a