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Exploring Minority Students' Perceptions of Using Open Educational Resources in a Computer Game Design Course

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Abstract: With the increasing use of open educational resources (OERs) in higher education, and the potential of OERs to enhance student learning, this study investigated minority students' perceptions of using OERs in learning computer programming. The influence of minority students' OER perceptions on their learning outcomes, as well as the relationships of the perception variables were explored. The participants were minority students from an HBCU institution in the southeastern United States. Quantitative approaches were used to analyze the collected data. The results indicated that the minority students' perceptions of using OERs had a significant influence on their perceived learning outcomes in learning computer programming. OER self-efficacy did not influence the minority students' perceived learning for programming. Understanding of OERs, OER interest, and OER self-efficacy significantly predicted the minority students' perceived value/usefulness of OERs in learning coding.

Keywords: open educational resource (OER); perceptions; self-efficacy; interest; minority students; computer programming



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1. Introduction

There has been growing interest in using open educational resources (OERs) in higher education (Clinton-Lisell & Kelly, 2024). Open educational resources (OERs) are free and easy to access, and the different levels of licensing provide users with permissions to reuse or re-create new materials or resources that are available to everyone at no cost (Clinton-Lisell, 2021). SPARC indicated that open educational resources (OERs) are the foundation of open education and defined OERs as “teaching, learning, and research resources that are free of cost and access barriers, and which also carry legal permission for open use” (SPARC, 2024, para. 6). OERs either reside in the public domain or have been released under a license that provides users “with free and perpetual permission to engage in the 5R activities—retaining, remixing, revising, reusing and redistributing the resources” (Hewlett, 2024, para. 3). UNESCO recommended the use of OERs and indicated that OERs have the potential to “support quality education that is equitable, inclusive, open and participatory as well as enhance academic freedom and professional autonomy of teachers by widening the scope of materials available for teaching and learning” (UNESCO, 2019, para. 16).

The high cost of commercial textbooks or materials is the driving force for the development of OERs (Clinton-Lisell, 2022). OERs can provide a no-cost alternative to commercial

textbooks, while still maintaining a high quality, which helps students to save money on their educational expenses, especially for those in higher education (Hilton, 2016; Hilton et al., 2019). Not purchasing a required textbook causes students to have a poor academic performance, and there is a higher chance of students withdrawing from courses with a significant textbook cost (Clinton-Lisell, 2022; Hilton et al., 2019). Considering the high cost of textbooks, students may obtain fewer course credits, which would lead to a delay in the completion of their degrees (Yue & Fu, 2017). Using OERs can benefit students in many ways and mitigate the issues resulting from the use of high-cost commercial textbooks or materials. For example, in a meta-analysis conducted by Clinton and Khan (2019), the withdrawal rates of courses with OER textbooks were 29% lower than those for courses using commercial textbooks.

OERs present in different forms, including textbooks, courses, music, videos, simulations, journal articles, tests, software, and other materials and resources that do not require access fees and are usually available online (Hilton, 2016; Clinton-Lisell, 2022). With OERs being no-cost and easily accessible, minority students and students with low socioeconomic status (SES) would greatly benefit from using OERs (Sergiadis et al., 2024). There is limited research on OERs conducted among minority students (Davis & Cartwright, 2020; Griffiths et al., 2022). Although OERs have been applied in various disciplines, there is a lack of studies on the use of OERs among minority students learning computer programming. To increase the understanding of the use of OERs to enhance students' learning in computer programming, this study aims to explore minority students' perceptions of OERs and how their perceptions affect the perceived learning outcomes.

2. Literature Review

2.1. Open Educational Resources for Minority Students

The use of OERs has the potential to promote diversity, equity, and inclusion (Watson et al., 2023). OERs provide everyone with free access to the knowledge and information that they want or need to learn and can create a meaningful and inclusive educational experience for students (DeBarger, 2020). OERs can benefit minority students by removing the cost barrier and enabling the equitable use of course materials (Sergiadis et al., 2024). Sergiadis et al. (2024) conducted a study of OERs related to equity, diversity, and inclusion and found that under-represented minority students were more influenced by financial barriers than white students when purchasing required textbooks. The cost of course materials was the major reason that prevented minority students from buying textbooks (Sergiadis et al., 2024). As for the equity of use and access, in non-OER courses, twice as many under-represented minority students than white students responded that they never used the required textbooks. In courses using OERs, the difference in textbook usage between the under-represented minority students and the white students decreased, and the overall usage for both the groups increased (Sergiadis et al., 2024).

2.2. Perceptions of Open Educational Resources and Their Relation to Learning Outcomes

In this study, the perceptions of OERs focused on the following four variables, including the understanding of OERs, OER interest, OER self-efficacy, and the perceived value/usefulness of OERs. This section introduced the concept of each perception variable proposed, as well as the relationship of these variables to the learning outcomes.

2.3. Understanding of OERs

It is important to possess a sufficient level of understanding of OERs before people use them for teaching or learning purposes (Butcher, 2015; Kuo et al., 2024). Students' level of understanding of OERs is likely to have an impact on their use of OERs to learn about

the content they are taught, especially when students are asked to create or develop OERs or artifacts related to the content they have learned (Lazzara et al., 2024). Knowledge of OERs may include the benefits of OERs, the purpose or potential of using OERs, the history of OERs, the type of open licensing, etc. (Butcher, 2015). We assumed students' level of understanding of OERs is critical to the students' outcomes in learning programming.

2.4. OER Interest

Interest is a motivational variable, and it refers to “a psychological state that occurs during interactions between persons and their objects of interest” (Hidi, 2006, p. 70). It is well documented that interest is a critical factor in enhancing students' learning and academic performance (O'Keefe et al., 2017). Increasing students' interest in learning greatly contributes to successful learning experiences and outcomes (Herpratiwi & Tohir, 2022). Students with a higher level of learning-related interest are more likely to put in more effort and become more engaged in the learning process compared to those with a lower level of interest (Kuo et al., 2023; O'Keefe et al., 2017). In technology-integrated learning settings, students' interest towards the use of a specific technology tool also plays an important role in their learning performance (Kuo et al., 2023). Therefore, in this study, OER interest is expected to have a positive impact on students' perceived learning outcomes in computer programming.

2.5. OER Self-Efficacy

Bandura (1994) defined self-efficacy as “People's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives” (Bandura, 1994, p. 71). The concept of self-efficacy is multifaceted, and it has been applied and studied in a variety of disciplines, such as information systems, business, and education (Kuo et al., 2014, 2020; Kuo & Kuo, 2023). Research has indicated that self-efficacy is related to and usually has a positive influence on educational outcomes (e.g., academic performance, achievement, and goal setting) (Walker et al., 2024; Bandura, 1994). In the last few decades, self-efficacy has been increasingly applied to the research on technology-based environments. The concept of self-efficacy related to different types of technology or digital resources has been developed, such as technology self-efficacy, Internet self-efficacy, and computer self-efficacy. This study focused on OER self-efficacy, which refers to the confidence level that users possess when using OERs for required tasks.

2.6. Perceived Value/Usefulness of OERs

Perceived value/usefulness, as a motivational factor, refers to “the idea that people internalize and develop more self-regulatory activities when experience is considered as valuable and useful for them” (Monteiro et al., 2015, p. 435). Derived from the self-determination theory, perceived value/usefulness reflects the intrinsic aspect of motivation that focuses on an individual's state of mind or intention to carry out an activity because of interest, joy, or meaningfulness (Pesonen et al., 2024; Teppo et al., 2021). Intrinsic motivation is one of the most important indicators of behavior and successful outcomes (Sisson & Whalen, 2024; Teppo et al., 2021). In research of technology-integrated learning, perceived usefulness also plays an important role in addressing one's acceptance or use of new technology (Kuo et al., 2023). Perceived usefulness related to the use of technology to enhance learning can be influenced by several factors, such as self-efficacy, interests, and prior experience (Kuo et al., 2023). Our study assumed that the understanding of OERs, OER interest, and OER self-efficacy may affect minority students' perceived value/usefulness of OERs.

2.7. Learning Technology Acceptance and Its Relation to OER Perceptions

Learning technology acceptance refers to the degree to which an individual accepts the use of a new or changing learning technology (Barak & Levenberg, 2016; Tseng et al., 2020). Technology acceptance addresses an individual's flexibility in a change in the learning environment that involves using new technology (Tseng et al., 2020). Students who are more willing to accept the planned use of new technology tools for a course are more likely to be successful in their learning (Kuo et al., 2023). Individuals' desire to accept or use new technology is associated with their beliefs or attitudes towards that technology, such as self-efficacy and perceived usefulness (Davis, 1989; Kim et al., 2015). In our study with OERs, we assume that minority students' learning technology acceptance may be correlated with their perceptions of OERs.

2.8. Research Questions

1. What are the minority students' perceptions of OERs?
2. Do the minority students' perceived learning outcomes in computer programming differ in terms of their understanding of OERs and OER interest?
3. Do the minority students' perceived learning outcomes in computer programming differ in terms of their perceived value of OERs in learning coding and OER self-efficacy?
4. How does the minority students' learning technology acceptance relate to their OER perceptions?
5. Do the minority students' understanding of OERs, OER interest, and OER self-efficacy predict their perceived value of OERs in learning coding?

3. Methods

3.1. Participants

The participants in this study were 24 minority students enrolled in an undergraduate game development course (see Table 1). The course was offered face-to-face in the College of Science and Technology at an HBCU (Historically Black Colleges and Universities) in the southeastern United States. The university is a four-year institution, with 95% of the students being minorities (including 86% Black people, 5% Hispanic people, and 4% other minorities). In this study, half of the participants were male students, and the other half were female students. All of the students were aged between 20 and 23 years old, except for one student who was above 23. All the students were minority students, with most of them being African American (92%). Most of the students were juniors (83.3%), and some were seniors (16.7%). In terms of their self-rated skills of computer coding/programming, 75% of the students indicated having basic skills, and about 20% of them had medium-level skills. None of them possessed a high level of computer coding/programming skills.

Table 1. Background information.

Characteristic	<i>n</i>	%
Gender		
Male	12	50
Female	12	50
Age		
20	7	29.2
21	11	45.8
22	2	8.3

Table 1. *Cont.*

Characteristic	<i>n</i>	%
23	3	12.5
29	1	4.2
Ethnicity		
African American	22	91.6
Hispanic	2	8.4
Grade level		
Junior	20	83.3
Senior	4	16.7
Skills related to computer coding/programming (self-rated)		
None	1	4.2
Basic level	18	75
Medium level	5	20.8
High level	0	0

3.2. Data Collection

The data were collected using an online survey. This study was approved by the university's Institutional Review Board (IRB), and informed consent forms were obtained from the students who participated in the survey. The online survey was provided to the students at the end of the class, which was also the end of the semester. The survey questionnaire consisted of sections, such as student background information, the perceptions of using OERs (i.e., the understanding of OERs, OER interest, the perceived value of OERs in learning coding, and OER self-efficacy), learning technology acceptance, and the perceived learning outcomes in computer programming (see Table 2). The student background information included gender, age, ethnicity, grade levels, and skills in computer coding/programming.

Table 2. Instruments.

Scales	Number of Items	Range	Cronbach's Alpha
Understanding of OERs	4	1–5	0.831
OER interest	4	1–5	0.900
Perceived value of OERs in learning coding	7	1–5	0.971
OER self-efficacy	9	1–5	0.973
Learning technology acceptance	5	1–6	0.953
Perceived learning outcomes in computer programming	39	1–5	0.991

Table 2 provides an overview of the scales used in this study. Both the scales, including OER interest and the perceived value of OERs in learning coding, were adapted from the motivation scale developed by [Deci and Ryan \(2000\)](#). The OER self-efficacy scale was adapted from the self-efficacy scale developed by [Pintrich and De Groot \(1990\)](#). The scale

of learning technology acceptance was developed by Barak and Levenberg (2016). The two scales, the understanding of OERs and the perceived learning outcomes in computer programming, were developed by the researchers. The scale of understanding of OERs measures one's knowledge about OERs. The scale of perceived learning outcomes in computer programming measured the students' learned knowledge and skills in computer programming acquired from the class. The items of these two scales were reviewed and verified by other faculty in the field. All of the scales were a 5-point Likert scale, except for the learning technology acceptance scale that was a 6-point Likert scale. The reliability values of scales in this study ranged from 0.83 to 0.99.

3.3. Context

The students enrolled in the game development course were required to use OERs to design and develop OER materials to teach programming to beginning learners. This OER project took three weeks to complete. Before the project began, the instructor taught the students about the concept of OERs and shared relevant OER platforms, examples, and resources. The major tasks for the students in this project included (1) designing practice in computer game coding; (2) developing OER instructional materials, including a user manual (lecture slides), demo videos, and coding scripts; and (3) applying one of the Creative Commons licenses to the materials the students developed.

3.4. Data Analysis

The data were analyzed using quantitative approaches. The quantitative approaches included descriptive analysis, *t*-tests, and correlation and regression analyses. SPSS 26 was used for data analyses.

4. Results

RQ1: What are the minority students' perceptions of OERs?

Table 3 shows the minority students' average scores for the six instruments that measured their perceptions of OERs. The average score of the students' understanding of OERs was 3.56, which is above the midpoint 3. The average score of the students' OER interest was 3.58. The students' perceived value of OERs in learning coding shows an average score of 3.65, and their average score of OER self-efficacy was slightly higher than the midpoint score 3 ($M = 3.48$, $SD = 1.00$). The students had a slightly high average score for technology acceptance ($M = 4.57$, $SD = 0.89$). The students' perceived learning outcomes in computer programming had a moderately average score ($M = 3.42$, $SD = 0.90$).

RQ2: Do the minority students' perceived learning outcomes in computer programming differ in terms of their understanding of OERs and OER interest?

T-test analyses (see Tables 4 and 5) show that levels of the minority students' understanding of OERs ($t = 2.43$, $p < 0.05$, $d = 1.05$) and OER interest ($t = 2.9$, $p < 0.01$, $d = 1.20$) had a significant influence on their perceived learning outcomes in computer programming. When looking into the three major sections of the students' perceived learning outcomes in computer programming, the students with high levels of understanding of OERs had significantly higher learning outcome scores in understanding ($t = 2.67$, $p < 0.05$, $d = 1.16$), application ($t = 2.34$, $p < 0.05$, $d = 1.01$), and problem solving ($t = 2.23$, $p < 0.05$, $d = 0.97$) in relation to programming compared to those with low levels of understanding of OERs. Similarly, the students with high levels of OER interest had significantly higher learning outcome scores in understanding ($t = 2.93$, $p < 0.01$, $d = 1.21$), application ($t = 2.87$, $p < 0.01$, $d = 1.19$), and problem solving ($t = 2.85$, $p < 0.01$, $d = 1.18$) in relation to programming compared to those of the students with low levels of OER interest.

Table 3. Descriptive information.

Scales	Range	Midpoint	<i>M</i>	<i>SD</i>
Understanding of OERs	1–5	3	3.56	1.01
OER interest	1–5	3	3.58	0.97
Perceived value of OERs in learning coding	1–5	3	3.65	0.99
OER self-efficacy	1–5	3	3.48	1.00
Learning technology acceptance	1–6	3.5	4.57	0.89
Perceived learning outcomes in computer programming	1–5	3	3.42	0.90

Table 4. *T*-test analysis of levels of understanding of OERs and perceived learning outcomes in computer programming.

	Low		High		<i>t</i> (22)	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Perceived learning outcomes in computer programming	2.84	1.00	3.71	0.72	2.43 *	0.024
Understanding of programming	2.80	1.01	3.75	0.70	2.67 *	0.014
Application of programming	2.84	1.00	3.69	0.75	2.34 *	0.029
Problem solving in programming	2.89	0.99	3.68	0.71	2.23 *	0.037

Note. * $p < 0.05$.

Table 5. *T*-test analysis of levels of OER interest and perceived learning outcomes in computer programming.

	Low		High		<i>t</i> (22)	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Perceived learning outcomes in computer programming	2.87	1.01	3.81	0.57	2.90 **	0.008
Understanding of programming	2.87	1.02	3.84	0.59	2.93 **	0.008
Application of programming	2.85	1.02	3.81	0.61	2.87 **	0.009
Problem solving in programming	2.89	1.00	3.80	0.55	2.85 **	0.009

Note. ** $p < 0.01$.

RQ3: Do the minority students' perceived learning outcomes in computer programming differ in terms of their perceived value of OERs in learning coding and OER self-efficacy?

T-test analyses (see Tables 6 and 7) show that the minority students' perceived value of OERs in learning coding ($t = 2.15$, $p < 0.05$, $d = 0.88$) had a significant influence on their perceived learning outcomes in computer programming. OER self-efficacy ($t = 1.85$, $p > 0.05$, $d = 0.76$) did not have a significant influence on their perceived learning outcomes in computer programming. When looking into the three major sections of the students' perceived learning outcomes in computer programming, the students with high levels of perceived value of OERs in learning coding had significantly higher learning outcome scores in understanding ($t = 2.40$, $p < 0.05$, $d = 0.98$) and application ($t = 2.11$, $p < 0.05$, $d = 0.86$) in relation to programming compared to those with low levels of understanding of OERs. No significant difference was found between the students with high and low levels of perceived value of using OERs to problem solve ($t = 1.92$, $p > 0.05$, $d = 0.79$) in programming. The students with high levels of OER self-efficacy did not have significantly higher learning outcome scores in understanding ($t = 1.95$, $p > 0.05$, $d = 0.80$), application

($t = 1.82, p > 0.05, d = 0.74$), and problem solving ($t = 1.74, p > 0.05, d = 0.71$) in relation to programming, compared to those of the students with low levels of OER self-efficacy.

Table 6. T-test analysis of perceived value of OERs in learning coding and perceived learning outcomes in computer programming.

	Low		High		<i>t</i> (22)	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Perceived learning outcomes in computer programming	3.02	0.89	3.76	0.78	2.15 *	0.043
Understanding of programming	2.99	0.91	3.81	0.76	2.40 *	0.025
Application of programming	3.00	0.90	3.75	0.82	2.11 *	0.046
Problem solving in programming	3.06	0.89	3.72	0.78	1.92	0.068

Note. * $p < 0.05$.

Table 7. T-test analysis of levels of OER self-efficacy and perceived learning outcomes in computer programming.

	Low		High		<i>t</i> (22)	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Perceived learning outcomes in computer programming	3.09	0.78	3.75	0.92	1.85	0.078
Understanding of programming	3.10	0.77	3.78	0.95	1.95	0.064
Application of programming	3.08	0.82	3.73	0.92	1.82	0.082
Problem solving in programming	3.12	0.78	3.71	0.91	1.74	0.096

RQ4: How does the minority students' learning technology acceptance relate to their OER perceptions?

Table 8 indicates the correlation of the minority students' technology acceptance with their OER perceptions, including the understanding of OERs, OER interest, OER self-efficacy, and the perceived value of OERs in learning coding. Technology acceptance was positively correlated with OER interest ($r = 0.45, p < 0.05$), OER self-efficacy ($r = 0.42, p < 0.05$), and the perceived value of OERs in learning coding ($r = 0.71, p < 0.05$). The students' perceived value of OERs in learning coding ($r = 0.40, p > 0.05$) was not significantly correlated with technology acceptance.

Table 8. Correlations among variables.

	Understanding of OER	OER Interest	OER Self-Efficacy	Perceived Value of OER in Learning Coding	Learning Technology Acceptance
Understanding of OER	—	0.77 *	0.85 **	0.85 **	0.40
OER interest		—	0.80 **	0.85 **	0.45 *
OER self-efficacy			—	0.78 **	0.42 *
Perceived value of OER in learning coding				—	0.71 *
Learning technology acceptance					—

Note. * $p < 0.05$; ** $p < 0.01$.

RQ5: Do the minority students' understanding of OERs, OER interest, and OER self-efficacy predict their perceived value of OERs in learning coding?

The multiple regression model (see Table 9) is significant; $F(3, 20) = 80.58, p < 0.001$, and Cohen's $f = 3.48$. The model explains 91% of the variance in the intention to adopt OERs. The understanding of OERs ($\beta = 0.771, p < 0.001$), OER interest ($\beta = 0.613, p < 0.001$) and OER self-efficacy ($\beta = 0.398, p < 0.051$) significantly predict the perceived value of OERs in learning coding. Among the three variables, the understanding of OERs was the strongest predictor of perceived learning.

Table 9. Multiple regression model: perceived value of OERs in learning coding explained by three predictor variables.

Variables	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>p</i>
Understanding of OERs	0.755	0.136	0.771	5.54	0.000 ***
OER interest	0.627	0.109	0.613	5.73	0.000 ***
OER self-efficacy	0.393	0.145	0.398	2.70	0.014 *

Note. * $p < 0.05$; *** $p < 0.001$.

5. Discussion

Based on the descriptive analyses, the averages of all the perception variables, including the understanding of OERs, OER interest, OER self-efficacy, and the perceived value of OERs in learning coding were all above the midpoint score three. This indicates that most of the minority students' perceptions of OERs were positive overall.

Based on the *t*-Test analyses, the levels of understanding of OERs, OER interest, and the perceived value of OERs in learning coding had a significant influence on the students' perceived learning outcomes in computer programming. This finding suggests that minority students with a higher level of understanding of OERs, more OER interest, and a higher perceived value of OERs in learning coding are more likely to have better perceived learning outcomes in computer programming, including understanding, application, and problem solving in programming. This result supports the importance of motivational variables (i.e., interest and perceived value/usefulness) in improving student learning experiences and outcomes (Herpratiwi & Tohir, 2022; Sisson & Whalen, 2024; Teppo et al., 2021). The positive influence of the understanding of OERs on the minority students' perceived learning outcomes supports the claim that possessing an adequate knowledge of OERs contributes to minority students learning with the use of OERs.

On the other hand, the level of OER self-efficacy was not found to have a significant impact on the minority students' perceived learning outcomes in computer programming, which contradicts previous findings of self-efficacy, where self-efficacy is often found to be the critical indicator of student outcomes (Walker et al., 2024; Bandura, 1994). This may be due to the short timeline of this project, where the students were exposed to OERs to learn and develop OER materials, which might not lead to significant differences in the students' scores for OER self-efficacy. Another speculation is that the OER self-efficacy may not be directly related to the perceived learning outcomes for computer programming. Even though the OER materials included the computer programming learning content, the creation of OER materials may demand more from the students for content organization and visual/graphic design. In other words, creating good OER materials for learning computer programming may not directly reflect a student's performance in computer programming. In addition, OER self-efficacy is usually related to the technology-related or technology integration self-efficacy of users (Kuo et al., 2024), which might explain the lack of significant results in computer programming performance.

Correlation analyses found that learning technology acceptance had a positive correlation with three OER perception variables in a significant way, including OER interest, OER self-efficacy, and the perceived value of OERs in learning coding. This finding indicates that minority students with higher levels of learning technology acceptance tend to have more interest and confidence in using OERs, as well as perceive a higher value of OERs in learning coding.

According to regression analysis, the understanding of OERs, OER interest, and OER self-efficacy were found to significantly predict the minority students' perceived value of OERs in learning coding. This implies that the minority students' understanding or knowledge of OERs, their interest towards the use of OERs, and their confidence level in using OERs had an influence on the degree to which they perceived OERs as valuable or useful resources or materials to learn coding. This finding supports research indicating the critical role that perceived usefulness plays for users to adopt new technology and the claim that other factors may affect perceived usefulness in technology-integrated learning settings (Kuo & Kuo, 2023; Kuo et al., 2023). Among the three predictors, the understanding of OERs and OER interest were most influential predictors of the minority students' perceived value of OERs in learning coding.

6. Conclusions and Implications

This study investigated minority students' perceptions of using OERs to create materials for learning coding or computer programming. Overall, the minority students' perceptions of OERs were quite positive, with a moderately high level of OER understanding, OER interest, perceived value of OER in learning coding, and OER self-efficacy. The minority students' perceived learning outcomes in computer programming (i.e., understanding, application, and problem solving in programming) differed significantly in terms of their understanding of OERs, OER interest, and the perceived value of OERs in learning coding. The level of OER self-efficacy did not have a significant impact on the minority students' perceived learning outcomes in computer programming. The minority students' learning technology acceptance was found to be significantly and positively correlated with their OER interest, OER self-efficacy, and the perceived value of OERs in learning coding. The understanding of OERs, OER interest, and OER self-efficacy significantly predicted the minority students' perceived value of OERs in learning coding.

This study has several practical implications for instructors, course developers, and administrators who are interested in using OERs for minority students. First, it is important to provide a training or information session on OERs to help minority students learn about OERs before using OERs in the class. Second, instructors should pay attention to minority students with a lack of interest or confidence in OERs or a low perceived value of OERs and provide them with support or assistance to enhance their interest levels in using OERs. Third, instructors should consider sharing successful examples of OER materials with students to enhance their interest or confidence in using OERs to develop the coding materials. In terms of the limitations of this study, we had a small sample with 24 students, and it is suggested that future studies include a larger sample to verify the findings of this study. The minority students in this study were African American students, and the results of this study may not be generalized to other groups of minority students, such as Hispanic or Native American students.

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References

- Bandura, A. (1994). Self-efficacy. In V. S. Ramachaudran (Ed.), *Encyclopedia of human behavior* (Vol. 4, pp. 71–81). Academic Press. (Reprinted in *Encyclopedia of mental health*, by H. Friedman, Ed., 1998, Academic Press).
- Barak, M., & Levenberg, A. (2016). Flexible thinking in learning: An individual differences measure for learning in technology-enhanced environments. *Computers & Education*, 99, 39–52. [CrossRef]
- Butcher, N. (2015). *A basic guide to open educational resources (OER)*. Commonwealth of Learning, Vancouver and UNESCO. Available online: <http://oasis.col.org/handle/11599/36> (accessed on 1 December 2024).
- Clinton, V., & Khan, S. (2019). Efficacy of open textbook adoption on learning performance and course withdrawal rates: A meta-analysis. *AERA Open*, 5(3), 2332858419872212. [CrossRef]
- Clinton-Lisell, V. (2021). Open pedagogy: A systematic review of empirical findings. *Journal of Learning for Development*, 8(2), 255–268. Available online: <https://jl4d.org/index.php/ejl4d/article/view/511> (accessed on 1 December 2024). [CrossRef]
- Clinton-Lisell, V. (2022). How does OER efficacy vary based on student age and course modality? *American Journal of Distance Education*, 37, 217–233. [CrossRef]
- Clinton-Lisell, V., & Kelly, A. E. (2024). The cost of doing homework: Online homework systems with access codes from a social justice perspective. *International Journal of Technology in Education and Science (IJTES)*, 8(2), 296–310. [CrossRef]
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340. [CrossRef]
- Davis, J. D., & Cartwright, S. B. (2020). The effects of using open educational resources on minority achievement in undergraduate mathematics. In *Advances in educational technologies and instructional design book series* (pp. 20–41). IGI Global. [CrossRef]
- DeBarger, A. (2020). *Our approach to systemic racism in Open Education*. Available online: <https://hewlett.org/our-approach-to-systemic-racism-in-open-education/> (accessed on 1 December 2024).
- Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227–268. [CrossRef]
- Griffiths, R., Mislevy, J., & Wang, S. (2022). Encouraging impacts of an Open Education Resource Degree Initiative on college students’ progress to degree. *Higher Education*, 84(5), 1089–1106. [CrossRef]
- Herpratiwi, H., & Tohir, A. (2022). Learning interest and discipline on learning motivation. *International Journal of Education in Mathematics Science and Technology*, 10(2), 424–435. [CrossRef]
- Hewlett. (2024). *Open educational resources*. Available online: <https://hewlett.org/strategy/open-education/> (accessed on 1 December 2024).
- Hidi, S. (2006). Interest: A unique motivational variable. *Educational Research Review*, 1(2), 69–82. [CrossRef]
- Hilton, J. (2016). Open educational resources and college textbook choices: A review of research on efficacy and perceptions. *Educational Technology Research and Development*, 64(4), 573–590. [CrossRef]
- Hilton, J., Larsen, R., Wiley, D., & Fischer, L. (2019). Substituting open educational resources for commercial curriculum materials: Effects on student mathematics achievement in elementary schools. *Research in Mathematics Education*, 21(1), 60–76. [CrossRef]
- Kim, B. W., Lee, W. G., Lee, B. R., & Shon, J. G. (2015). Influencing factors in OER usage of adult learners in Korea. *The International Review of Research in Open and Distributed Learning*, 16(2), 1–17. [CrossRef]
- Kuo, Y. C., Kuo, Y. T., & Abi-El-Mona, I. (2023). Mobile learning: Pre-service teachers’ perceptions of integrating iPads into future teaching. *Education and Information Technologies*, 28(6), 6209–6230. [CrossRef] [PubMed]
- Kuo, Y. C., Kuo, Y. T., & Tseng, H. (2024). Exploring the factors that influence K-12 teachers’ use of open educational resources. *Education Sciences*, 14(3), 276. [CrossRef]
- Kuo, Y. C., Tseng, H., & Kuo, Y. T. (2020). Internet self-efficacy, self-regulation, and student performance: African-American adult students in online learning. *International Journal on E-learning*, 19(2), 161–180.
- Kuo, Y. C., Walker, A. E., Schroder, K. E., & Belland, B. R. (2014). Interaction, Internet self-efficacy, and self-regulated learning as predictors of student satisfaction in online education courses. *The Internet and Higher Education*, 20, 35–50. [CrossRef]

- Kuo, Y. T., & Kuo, Y. C. (2023). African American students' academic and web programming self-efficacy, learning performance, and perceptions towards computer programming in web design courses. *Education Sciences*, 13(12), 1236. [CrossRef]
- Lazzara, J., Bloom, M., & Clinton-Lisell, V. (2024). Renewable assignments: Comparing faculty and student perceptions. *Open Praxis*, 16(4), 514–525. [CrossRef]
- Monteiro, V., Mata, L., & Peixoto, F. (2015). Intrinsic motivation inventory: Psychometric properties in the context of first language and mathematics learning. *Psicologia Reflexão E Crítica*, 28(3), 434–443. [CrossRef]
- O'Keefe, P. A., Horberg, E. J., & Plante, I. (2017). The multifaceted role of interest in motivation and engagement. In *Springer eBooks* (pp. 49–67). Springer. [CrossRef]
- Pesonen, H., Leikas, S., & Malmi, L. (2024). You can learn well regardless of your motivation type—Evidence from a virtual learning environment. *Learning and Motivation*, 88, 102069. [CrossRef]
- Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology*, 82(1), 33–40. [CrossRef]
- Sergiadis, A., Smith, P., & Uddin, M. (2024). How equitable, diverse, and inclusive are open educational resources and other affordable course materials? *College & Research Libraries*, 85(1), 44–63. [CrossRef]
- Sisson, A. D., & Whalen, E. A. (2024). Engaging in student evaluations of teaching through intrinsic motivation: An exploratory study of competence, perceived choice, value/usefulness, and relatedness. *Journal of Teaching in Travel & Tourism*, 24(2), 189–202. [CrossRef]
- SPARC. (2024). *Open education*. Available online: <https://sparcopen.org/open-education/> (accessed on 1 December 2024).
- Teppo, M., Soobard, R., & Rannikmäe, M. (2021). A study comparing intrinsic motivation and opinions on learning science (Grades 6) and taking the international PISA Test (Grade 9). *Education Sciences*, 11(1), 14. [CrossRef]
- Tseng, H., Kuo, Y., & Walsh, E. J. (2020). Exploring first-time online undergraduate and graduate students' growth mindsets and flexible thinking and their relations to online learning engagement. *Educational Technology Research and Development*, 68(5), 2285–2303. [CrossRef]
- United Nations Educational, Scientific, and Cultural Organization. (2019). *UNESCO recommendation on open educational resources (OER)*. Available online: <https://www.unesco.org/en/legal-affairs/recommendation-open-educational-resources-oer> (accessed on 1 December 2024).
- Walker, A., Aguiar, N., Soicher, R., Kuo, Y. C., & Resig, J. (2024). Exploring the relationship between motivation and academic performance among online and blended learners: A meta-analytic review. *Online Learning*, 28(4), 75–115.
- Watson, C. E., Petrides, L., Karaglani, A., Burns, S., & Sebesta, J. (2023). *Leveraging open educational resources to advance diversity, equity, and inclusion: A guide for campus change agents*. American Association of Colleges and Universities (AAC&U) and Institute for the Study of Knowledge Management in Education (ISKME).
- Yue, H., & Fu, X. (2017). Rethinking graduation and time to degree: A fresh perspective. *Research in Higher Education*, 58(2), 184–213. [CrossRef]

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