Index and Sustainability Status of Digital Literacy in Riau Province, Indonesia

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Abstract. The main objective of this research is to identify the index and sustainability status of digital literacy mastery in higher education. Multidimensional scaling (MDS) analysis was used as a problem-solving approach with the help of RapLiteracy software (modified from Rapfish software). The first stage is to determine the sustainability attributes of each dimension or indicator. Next, scoring the sustainability of each attribute is done with the help of the cheat sheet that has been provided. The next stage is to analyze the data that has been collected using RapLiteracy software. The results of the analysis show that the sustainability status of digital literacy mastery in higher education is in the moderately sustainable category. A holistic strategy is needed to support the sustainable development goals set by the government. Of course, the strategy must accommodate the interests of related parties.

Keywords: Administrator, Sub district Head, Development.

1 Introduction

The education paradigm continues to evolve [1] [2] [3]. Digital literacy plays an important role in realising digital transformation, especially in education. [4]. Digital literacy is mastery of technology ethically and effectively, which is essential for academic civilization to support the learning process and professional skills development [5]. The application of digital literacy is important to improve 21st century skills with effective project-based learning strategies that integrate technology interactively and encourage students' active participation in solving real problems collaboratively.

Digital literacy requires not only basic skills in the use of technology, but also a deep understanding of how technology can be used for curriculum, learning strategies, and academic research [7] [8] [9]. We expect the academic community, comprising teachers, students, and lecturers, to not only comprehend technology but also leverage it to foster innovation in learning and research [10] [11]. Only with a strong foundation in digital literacy and the support of adequate facilities and infrastructure can these ideas be realized. Data-driven adaptive learning activities are one way to innovate. It involves using technology to analyze student needs in real-time.

However, amidst rapid technological advances and increasing access to digital devices, it is still difficult to ensure that digital literacy is uniformly and sustainably

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implemented throughout academic civilization [12]. Although there are some initiatives aimed at increasing digital literature among academics, this issue still requires serious [13] [14]. Measuring a person's mastery of digital literacy can be assessed through particularly critical, cognitive, social, operative, emotional, and projective abilities. This research can investigate how technology can be used in learning. It can encourage students and lecturers to think critically in solving problems, work together in teams, manage emotions when facing technological challenges, and project innovations that suit the needs of industry and society.

Digital literacy is now a must in an era where technology and information are growing rapidly [15] [16]. In Riau Province, which is one of the countries with technological developments starting to flourish, it is vital to assess to what extent digital literacy has been used and how it supports modern skills among academics [17]. In order to create effective policies and programs to enhance digital literacy sustainably, local governments and educational institutions must understand the current state of the sustainability of digital literature [18] [19].

Although digital literacy has been discussed extensively in some previous research, there are still some gaps that need to be filled. Previous research focused more on how students understood digital literacy without considering the role of the entire academic community, including lecturers and teachers [20] [21] [22]. Digital literacy requires an understanding of how to access, manage, analyse and use digital information [23] [24].

This research has produced some major advances compared to previous research. First, this research will identify the value of the index and sustainability set of digital literacy specific to academic civitas in Riau Province, Indonesia. It is hoped that this index, taking into account elements relevant to local conditions, can provide a more accurate and comprehensive picture of the level of digital literacy that students and lecturers have. Second, the study will examine how digital literature can be improved and enhanced as technology develops and the changing needs of the world of education. Thus, this research will not only contribute to academic literature but also provide practical insights for policymakers and educational institutions in formulating digital literacy enhancement strategies.

2 Methods

Researchers use a descriptive approach to describe concretely the real situation. The checklist-assisted interview was the tool used in data collection. Interviews are conducted with two approaches: structured and semi-structured interviews. The interview respondent selection technique is carried out using a nonprobability approach through purposive sampling. The selected respondents are those who are most familiar with the application of digital literacy at the state universities in Riau Province, Indonesia.

Interviews were conducted using the Rapid Rural Appraisal (RRA) approach. Through this RRA approach, the needs of stakeholders (lecturers, students, faculty leaders, and experts) will be identified in implementing digital literacy at state universities in Riau Province, Indonesia. The set of statements provided were considered to explain each aspect of the assessment of the sustainability of the implementation of digital literacy and skills in the 21st century. Researchers used a checklist sheet and then identified or ticked respondents' answers or opinions regarding existing conditions in higher education and then compared them with criteria or indicators for the sustainability of digital literacy and indicators of 21st century skills. The value given to the responses given by respondents was marked with the numbers 0 (poor), 1 (medium), and 2 (good).

Multidimensional scaling assisted by RapLiteracy software (modified Rapfish) was used to analyze the index and sustainability status. The stages are: (1) to establish the sustainability attributes of each indicator; (2) giving a score according to the level of sustainability; (3) applying the score to the software; and (4) analyzing the sustainability index and status.

From this multidimensional analysis, the sustainability status of the research object is described. (unsustainable, quite sustainable, sufficiently sustainable, and highly sustainable). RapLiteracy, a modification of the Rapfish software, is an approach that evaluates the sustainability of each indicator or aspect of research as a whole. This method provides a thorough understanding of a person or group's capacity to use technology sustainably and effectively. Researchers can use this RapLiteracy program to find areas that need improvement to support the overall and sustainable improvement of digital literacy.

3 Finding and Discussion

Based on the framework, there are six main abilities needed to master digital literacy. Here are the results.

3.1 Critical Indicators

MDS analysis with RapLiteracy software was first performed on a dimension or critical indicator. Next, researchers identified the sensitive attributes of each parameter using leverage analysis. In multidimensional scale analysis (MDS), power analysis is used to find the features that most influence the final outcome. This allows the focus to be on making improvements to enhance performance or sustainability within the observed dimension. The sustainability index refers to the following intervals: 0 - 25.00 (unsustainable); 25.01-50.00 (less sustainable); 50.01-75.00 (quite sustainable); and 75.01-100 (very sustainable). The following image displays the analysis's findings:

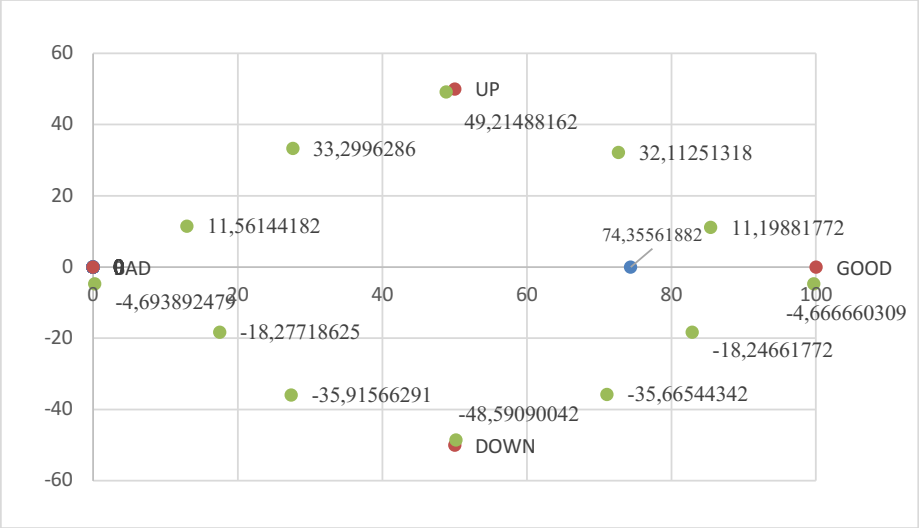

Fig. 1. Position of critical indicator sustainability status

In the critical dimensions or indicators, the index value and sustainability status are at 74.35. This indicates that critical indicators are in the moderately sustainable category because they are in the range of 50.01-75.00. Further identification can be made based on leverage analysis of the five attributes that have been established. There are two main attribute positions with high emphasis: accessibility and digital infrastructure attribution with a sustainability rating of 13.24 and technical ability and digital skills attribution with a durability rating of 11.87. More is presented in the following picture:

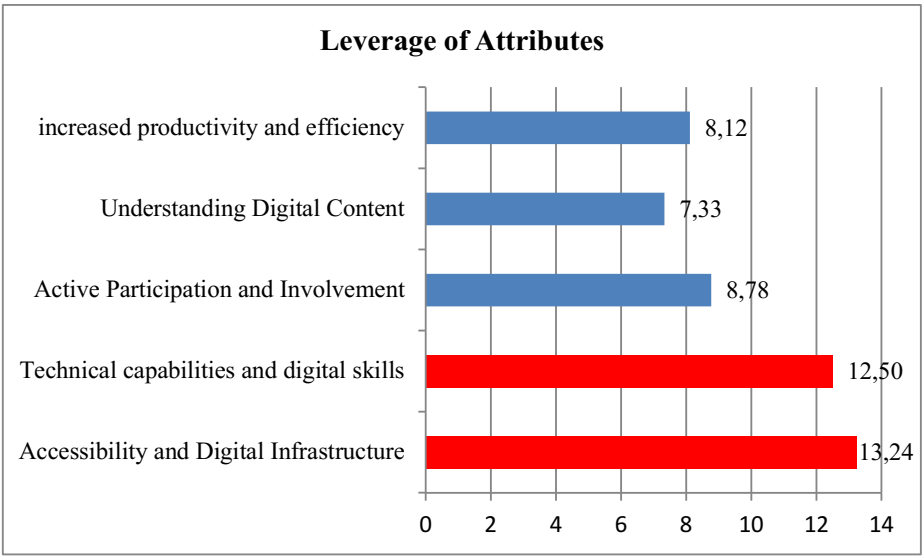

Fig. 2. Results of leverage analysis of each attribute on critical indicator

The two attributes marked with red-colored lines indicate that these two attributes have a more dominant value than the attributes with blue-colored lines. So it can be concluded that the two main attributes are the determining factors for the sustainability of the application of digital literacy in the 21st century skills of the academic community in higher education.

3.2 Cognitive Indicators

The second MDS analysis was conducted on cognitive dimensions or indicators. The following figure shows the results of the analysis.

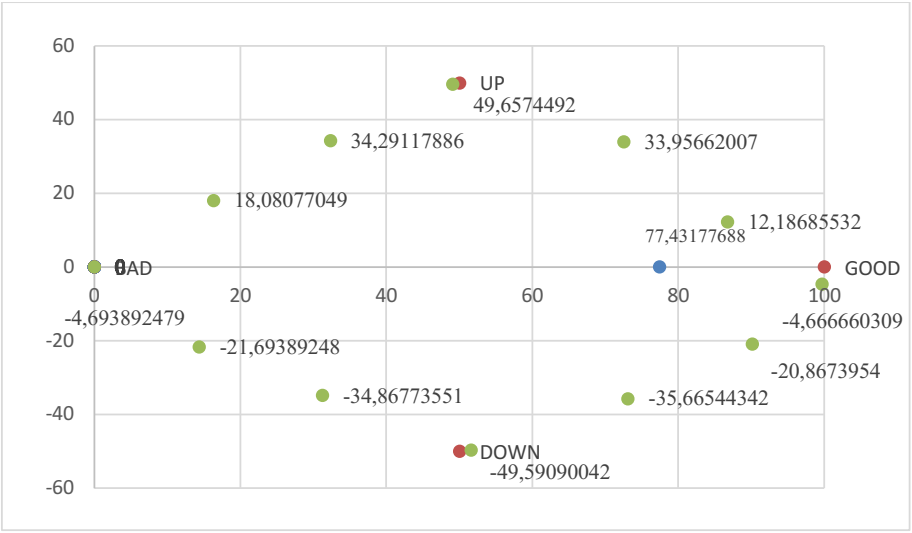

Fig. 3. Position of cognitive indicator sustainability status

In the cognitive dimension, the index value is 77.43. This reflects that this dimension is highly sustainable. The leverage analysis also identified the sensitivity of the five attributes used. There are two main attributes with high power positions, namely the ability to adapt quickly to the change of technology and digital trends with a sustainability value of 13.17 and the ability to use digital literacy to solve problems with a sustainability of 11.71. More is presented in the following picture:

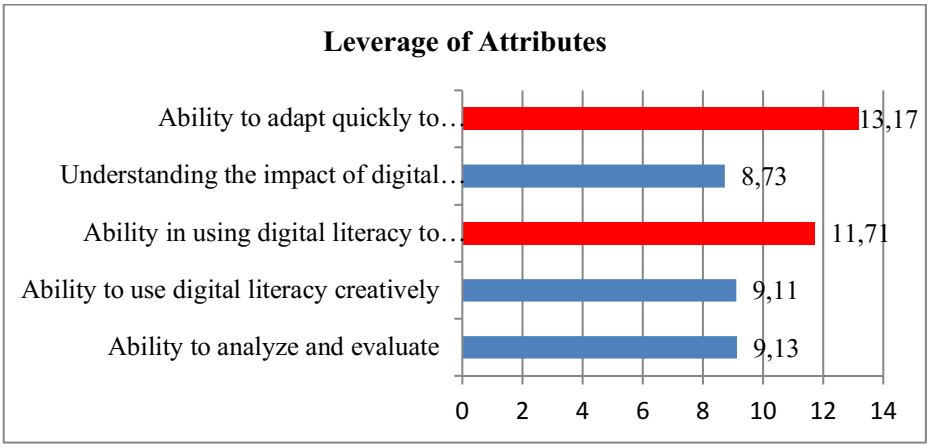

Fig. 4. Results of leverage analysis of each attribute on the cognitive indicator

When viewed in the results above, there are two sensitive attributes. So these two attributes are identified as attributes that determine the sustainability of digital literacy implementation in higher education in this dimension.

3.3 Social Indicators

MDS analysis, with the help of RapLiteracy software, is carried out on a third dimension, or social indicator. The results of the analysis can be seen in the following image

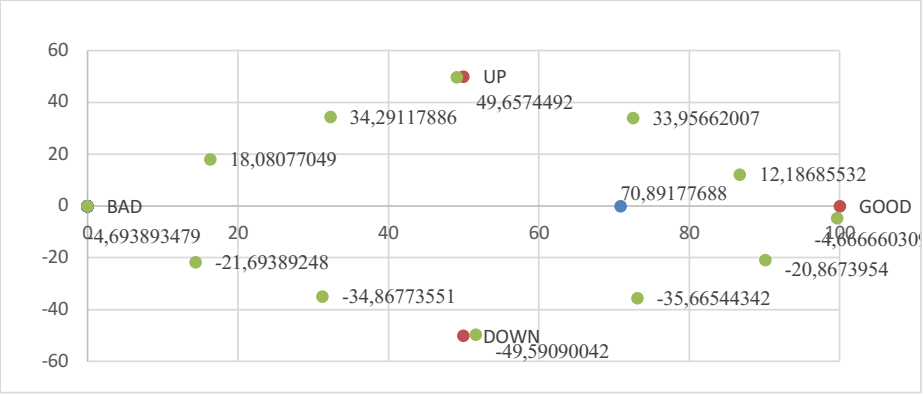

Fig. 5. Position of social indicator sustainability status

In this social dimension or indicator, the sustainability status is only in the moderately sustainable category. This condition is characterized by an index value of only 70.89. Further identification can be made based on leverage analysis of the five attributes that have been established. There are two main attributes with high power positions, namely communication participation and collaboration, with a sustainability rating of 13.70, and the attributive empowerment of academic civitas through digital literacy, with a sustainability value of 12.29. More is presented in the following picture:

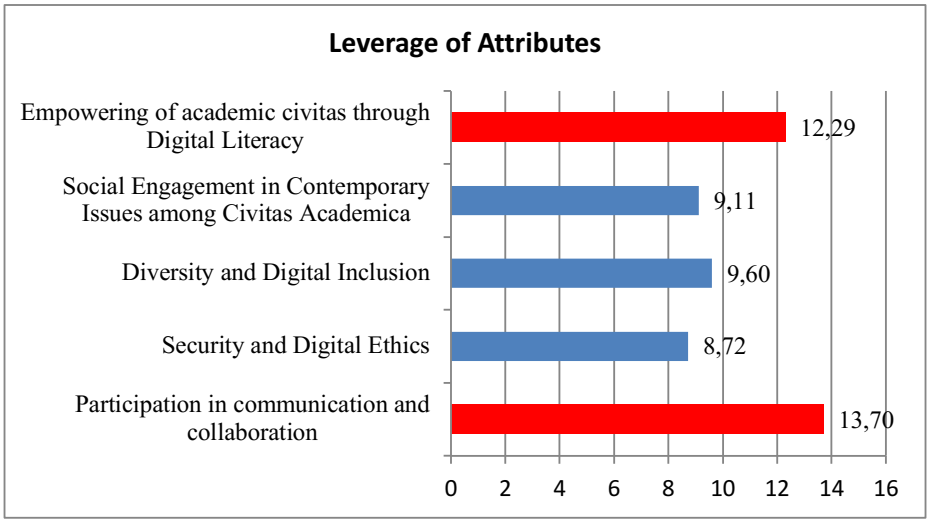

Fig. 6. Results of leverage analysis of each attribute on social indicators

It can be concluded that these two main attributes are said to be an attribute of reference because they have a more dominant value than the others, thus being a determining factor in the sustainability of the application of digital literacy to the skills of the 21st century Civitas Academica in colleges.

3.4 Operative Indicators

MDS analysis, with the help of RapLiteracy software, is carried out on a third dimension, or operative indicator. Figure 7 presents the results of the analysis.

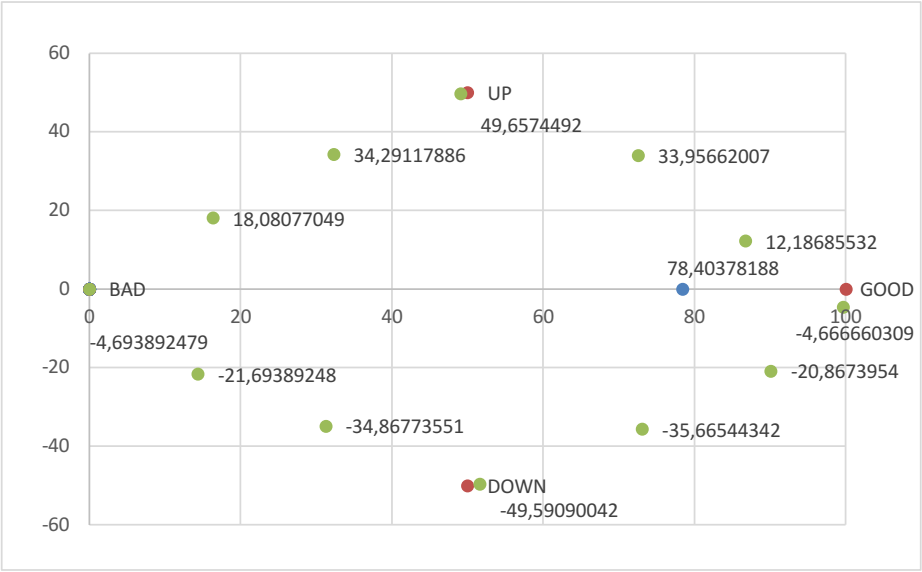

Fig. 7. Position of operative indicator sustainability status

The operative dimension or indicator shows a very sustainable status. This condition is characterised by an index value of 78.40. Further identification can be made based on leverage analysis of the five attributes that have been established. There are two main attribute positions with high emphasis, namely adaptation to technological change with a sustainability value of 13.73 and the use of collaborative platforms and effective communication with a sustainability of 13.45. More is presented in the following picture:

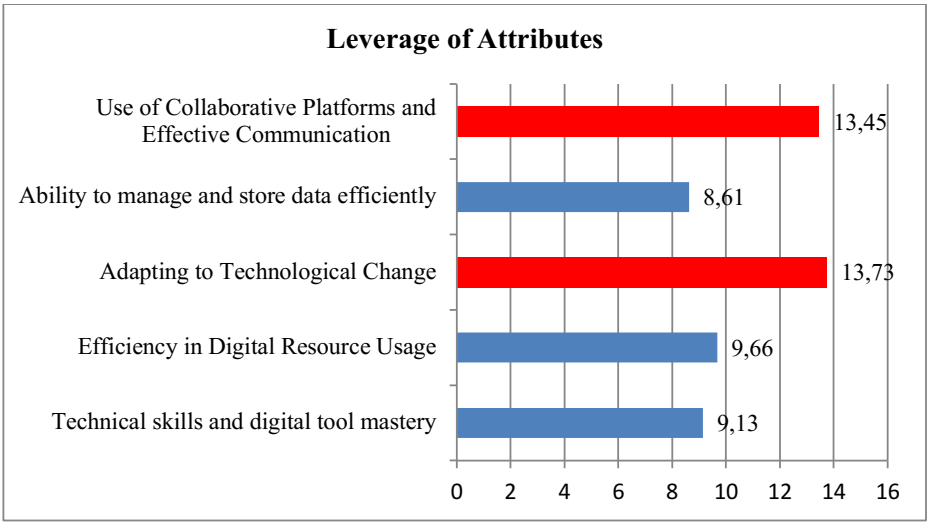

Fig. 8. Results of leverage analysis of each attribute on operative indicators

It can be concluded that these two main attributes are said to be an attribute of reference because they have a more dominant value than the others. Both are made attributes that determine the sustainability of this dimension or indicator.

3.5 Emotional Indicators

MDS analysis, with the help of RapLiteracy software, is carried out on a third dimension, or emotional indicator. Here are the results of the analysis:

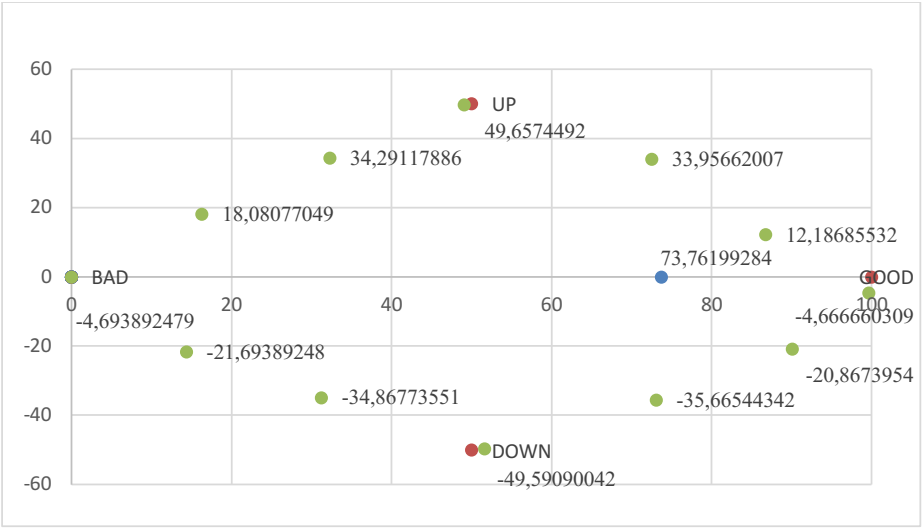

Fig. 9. Position of emotional indicator sustainability status

In the emotional dimension or indicator, the sustainability status is categorized as fairly sustainable. This condition is marked by an index value that is only at 73.76. Further identification can be made based on leverage analysis of the five attributes that have been set. There are two main attributes with high emphasis, namely the attribute of emotional awareness of the impact of digital content with a sustainability rating of 12.67 and the attribute of the ability to manage stress in the use of technology with a sustainability value of 11.49. More is presented in the following picture:

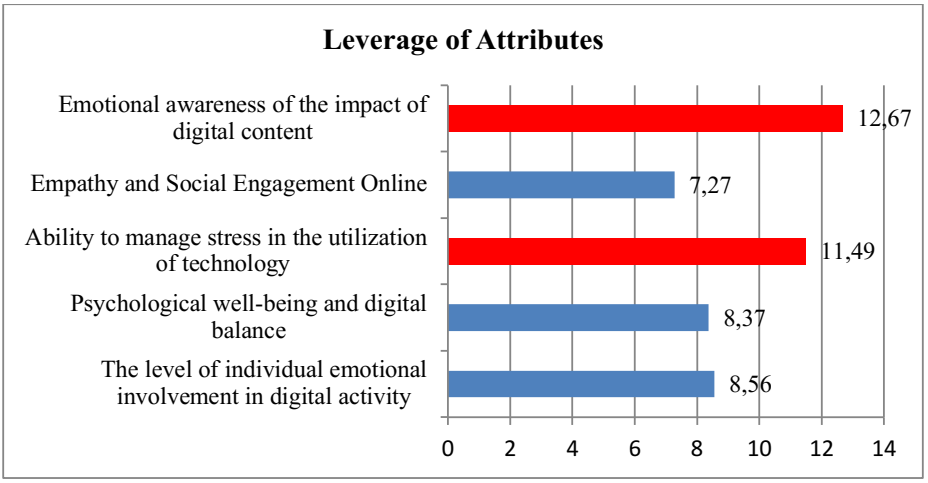

Fig. 10. Results of leverage analysis of each attribute on emotional indicators

It can be concluded that these two main attributes are said to be an attribute of reference because they have a more dominant value than the others. Both are made attributes that determine the sustainability of this dimension or indicator.

3.6 Projective Indicators

MDS analysis, with the help of RapLiteracy software, is carried out on a third dimension, or projective indicator. Here are the results of the analysis:

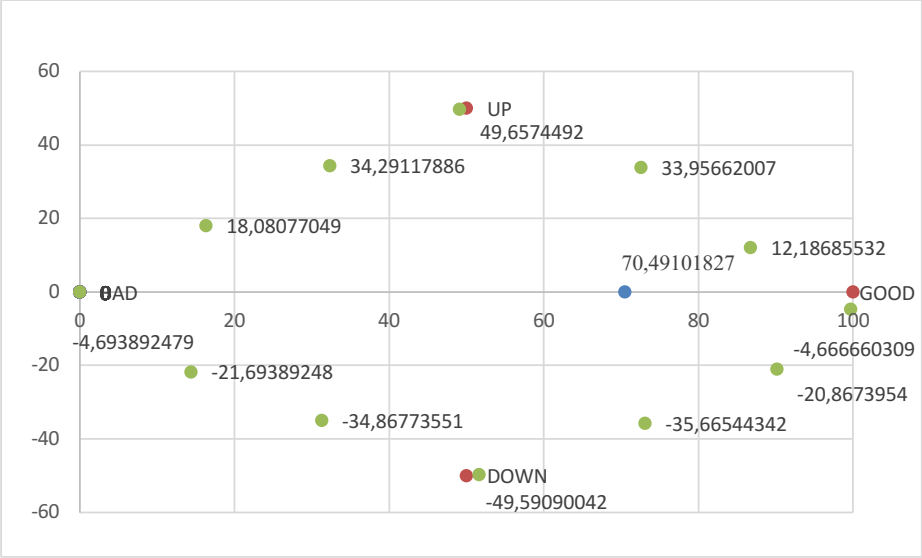

Fig. 11. Position of projective indicator sustainability status

The dimensions or projective indicators show that its sustainability status falls into the category of quite sustainable. This condition is marked by an index value of 70.49. Further identification can be made based on a leverage analysis of the five attributes that have been set. There are two main attributes with high emphasis, namely the collaborative project and team collaboration attribute with a sustainability rating of 13.82 and the digital project management and timeline attribute with a durability value of 12.61. More is presented in the following picture:

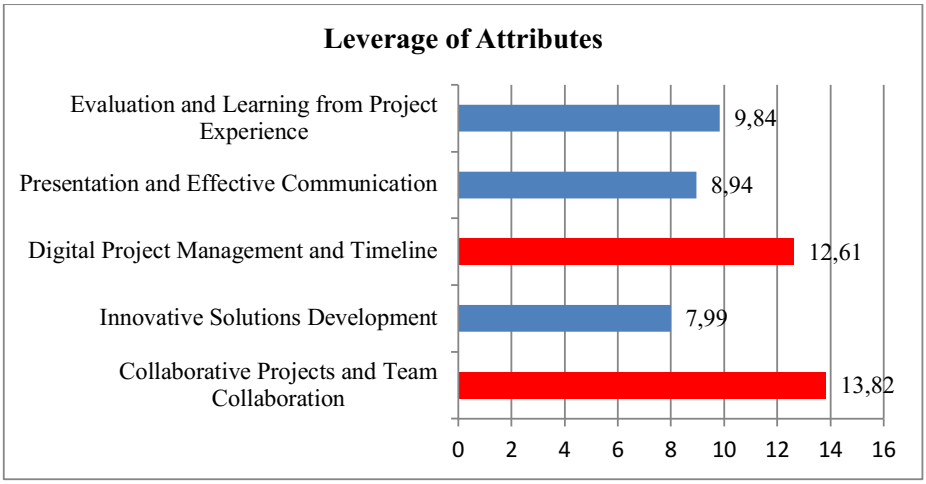

Fig. 12. Results of leverage analysis of each attribute on projective indicators

It can be concluded that these two main attributes are said to be an attribute of reference because they have a more dominant value than the others. Both are made attributes that determine the sustainability of this dimension or indicator.

3.7 Multi-Dimensional Sustainability Status

From the results of the RapLiteracy analysis above, the multidimensional sustainability status of the application of digital literacy to the skills of the 21st century is at a value of 74.22, where this value is in the range of 50,01–75,00, with a very sustainable category. This condition gives a picture that the updating of 21st century skills students at colleges is in a rather sustainable category and needs to be a special concern for stakeholders in achieving this level of sustainability. Graphically presented in the following picture:

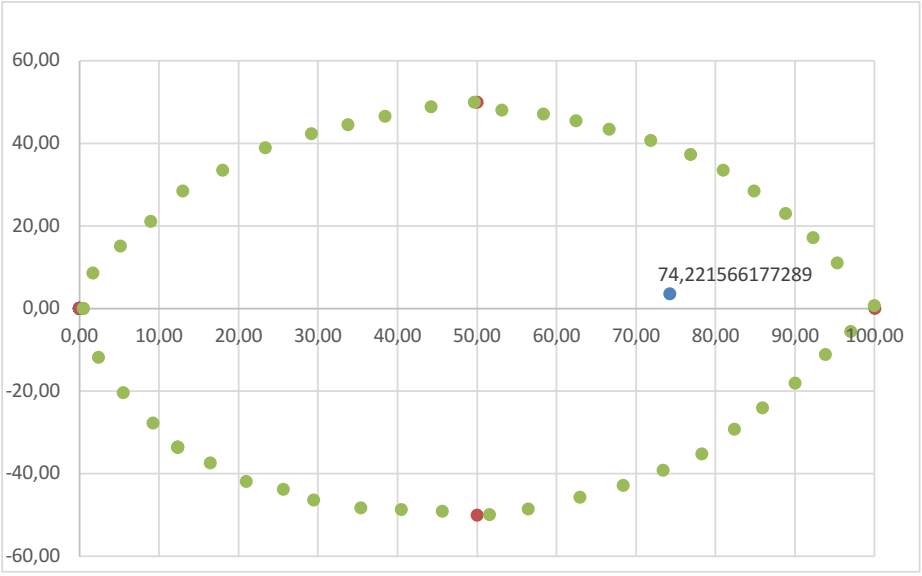

Fig. 23. The degree of multidimensional sustainability of digital literacy to 21st century skills at Civitas Akademika College in Riau Province, Indonesia

Multidimensional analysis indicates that there are 12 sensitive attributes that can affect the index and sustainability of digital literacy skill implementation. Further presented are the sensitive attributes of each indicator in the following table:

Table 1.Sensitive Attributes Affecting Sustainability Indices in Digital Literacy Applications.

Indicators	Sensitive Attribute
Critical	1. Accessibility and digital infrastructure 2. Technical capabilities and digital skills
Cognitive	1. Ability to adapt quickly to technological change 2. Ability in using digital literacy to solve problems
Social	1. Participation in communication and collaboration 2. Empowerment of academic citizenship through digital literacy
Operative	1. Adaptation to technological change 2. Use of collaborative platforms and effective communication
Emotional	1. Emotional awareness of the impact of digital content 2. Ability to manage stress in the utilization of technology
Projective	1. Collaborative projects and team collaborations 2. Digital project management and timeline

Source: Primary Data, 2024

21st century skills not only include technical skills in using technology but also include critical thinking skills, collaboration, communication, and creativity [25] [26] [27]. This statement is certainly in line with the opinion of Suyatno et al who said that digital literacy is a vital component in developing these skills, as it enables students and academic citizens to access information, solve problems effectively, and innovate in an ever-expanding digital environment [28]. Therefore, the sustainability score of 74.22 indicates that despite significant efforts, there is still room for improvement in the integration of digital literacy with 21st-century skills at colleges in Riau Province, Indonesia.

Research results show that digital infrastructure and accessibility are crucial to ensuring modern skills are used in colleges [29]. This finding reinforces the justification provided by Rawal that the digital infrastructure includes the software and hardware, such as computers, tablets, and smartphones, that are needed to help students learn [30]. Besides, fast and stable internet speeds are crucial, especially in an era when many academic tasks are done online [31]. This finding is in line with previous research, which stated that the digital divide would be wider if there were no equal access, which could hinder the development of modern skills across the region [32].

The next determining factor is digital and technical skills, which are basic skills that students must have to make optimal use of technology. These skills include understanding the basic concepts of information and communication technology (ICT), being able to operate software, and using digital tools for learning [33]. This result is in line with the idea [34] that digital skills are not limited to the use of technology; knowledge about cyber security, data privacy, and digital ethics are also important [34].

The ability to adapt quickly to technological change is becoming crucial. To remain relevant to technological advances, academic disciplines must be able to keep up with these advances [35]. The ability to adapt to these requires openness to lifelong learning, which means that students, teachers, and employees must always be prepared to use new technologies in academic and administrative activities [36]. Digital literacy is more than just the ability to use technology and how to use it to solve problems. It also includes the capacity to find, evaluate, and use digital information correctly. Strong digital literacy in higher education enables students and teachers to do better research, create new ideas, and improve the quality of learning [37].

Communication and collaboration are the next components that also play a major role. In the twenty-first century, communicating and collaborating are essential skills that must be promoted in an academic environment to accelerate adaptation [33]. In the age of globalization, the ability to communicate and collaborate effectively with others, both directly and through digital platforms, is becoming increasingly important [38]. This finding is confirmed by research conducted by Kim who emphasised that active participation in digital collaboration at colleges enables more dynamic and innovative exchanges of ideas [39]. In research projects, they can work together, share resources, and solve problems collectively. Not only is it necessary to be able to adapt quickly, but institutions must also be prepared to update and improve

existing technology systems. The university must have a long-term plan to implement new technologies in administration and curriculum.

Using collaborative platforms and effective communication is an essential part of 21st-century skills. Project management tools and online discussion forums are examples of collaborative platforms that enable the academic community to work together more efficiently and productively [40]. In addition, it is important for academics to understand the code of ethics of digital communication, which covers ways to communicate professionally and politely in an online context. Emotional awareness of the impact of digital content refers to how academics understand how digital content can affect their emotional and mental well-being. This includes the ability to recognize the symptoms of anxiety or stress that may be caused by the use of technology and how to manage those feelings. Colleges in Riau Province must develop programs that help students and teachers manage the emotional impact of the use of technology, including health education.

Besides, the stress management aspects associated with the use of technology are an additional component that is crucial to the utilization of modern skills. Although it has many benefits, technology can also cause stress if not properly managed. College alumni may face challenges such as the need to stay connected, the increasing workload due to ease of access to the Internet, and concerns about rapid technological developments [41]. It's clearly not apart from teamwork and collaborative projects, which are also important components in the development of this century's skills. When students and lecturers work together in teams, they can more effectively share knowledge, improve social skills, and achieve common goals. To achieve this, academic civitas must have effective digital project management and timing. Digital project management includes project planning, management, and implementation using digital tools and technologies. Effective timing is also important to ensure that each team member understands their responsibilities, deadlines, and expected outcomes.

By paying attention to and developing these factors, colleges can create an academic environment that supports the development of digital and non-digital skills, as well as preparing students and lecturers to face the challenges of the technological age.

4 Conclusion

Effective learning can be supported by digital literacy skills. The results of a comprehensive analysis conducted on the level of sustainability of digital literacy mastery in higher education indicate a level of sustainability in the moderately sustainable category. Stakeholders are expected to be able to develop a holistic policy recommendation to realize digital literacy skills in the 21st century. With policy recommendations that accommodate the needs of the parties, it is expected to support the sustainable development goals (SDGs) that have been launched by the government.

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References

1. Leal Filho W, Lange Salvia A, Beynaghi A, Fritzen B, Ulisses A, Avila LV, Shulla K, Vasconcelos CR, Moggi S, Mifsud M, Anholon R. Digital transformation and sustainable development in higher education in a post-pandemic world. International Journal of Sustainable Development & World Ecology. 2024 Jan 2;31(1):108-23. https://doi.org/10.1080/13504509.2023.2237933
2. Yang C, Xiu Q. A bibliometric review of education for sustainable development, 1992–2022. Sustainability. 2023 Jul 10;15(14):10823 https://doi.org/10.3390/su151410823
3. Rasa T, Laherto A. Young people's technological images of the future: implications for science and technology education. European Journal of Futures Research. 2022 Dec;10(1):4. https://doi.org/10.1186/s40309-022-00190-x
4. Thornhill-Miller B, Camarda A, Mercier M, Burkhardt JM, Morisseau T, Bourgeois-Bougrine S, Vinchon F, El Hayek S, Augereau-Landais M, Mourey F, Feybesse C. Creativity, critical thinking, communication, and collaboration: assessment, certification, and promotion of 21st century skills for the future of work and education. Journal of Intelligence. 2023 Mar;11(3):54. https://doi.org/10.3390/jintelligence11030054
5. Homen M, Dumancic M. Report on smart education in the Republic of Croatia. InSmart Education in China and Central & Eastern European Countries 2023 Jan 31 (pp. 109-130). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-19-7319-2_5
6. Althibyani HA, Al-Zahrani AM. Investigating the effect of students' knowledge, beliefs, and digital citizenship skills on the prevention of cybercrime. Sustainability. 2023 Jul 25;15(15):11512. https://doi.org/10.3390/su151511512
7. Southworth J, Migliaccio K, Glover J, Reed D, McCarty C, Brendemuhl J, Thomas A. Developing a model for AI Across the curriculum: Transforming the higher education landscape via innovation in AI literacy. Computers and Education: Artificial Intelligence. 2023 Jan 1;4:100127.https://doi.org/10.1016/j.caeai.2023.100127
8. Sharma Y, Suri A, Sijariya R, Jindal L. Role of education 4.0 in innovative curriculum practices and digital literacy–A bibliometric approach. E-Learning and Digital Media. 2023:20427530231221073. https://doi.org/10.1177/204275302312210
9. Alenezi M. Digital learning and digital institution in higher education. Education Sciences. 2023 Jan 13;13(1):88. https://doi.org/10.3390/educsci13010088
10. Ammar M, Al-Thani NJ, Ahmad Z. Role of pedagogical approaches in fostering innovation among K-12 students in STEM education. Social Sciences & Humanities Open. 2024 Jan 1;9:100839. https://doi.org/10.1016/j.ssaho.2024.100839
11. Akimov N, Kurmanov N, Uskelenova A, Aidargaliyeva N, Mukhiyayeva D, Rakhimova S, Raimbekov B, Utegenova Z. Components of education 4.0 in open innovation competence frameworks: Systematic review. Journal of Open Innovation: Technology, Market, and Complexity. 2023 Jun 1;9(2):100037. https://doi.org/10.1016/j.joitmc.2023.100037
12. Jarjabka Á, Sipos N, Kuráth G. Quo vadis higher education? Post-pandemic success digital competencies of the higher educators–a Hungarian university case and actions. Humanities

and Social Sciences Communications. 2024 Feb 24;11(1):1-1. https://doi.org/10.1057/s41599-024-02809-9
13. Timotheou S, Miliou O, Dimitriadis Y, Sobrino SV, Giannoutsou N, Cachia R, Monés AM, Ioannou A. Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review. Education and information technologies. 2023 Jun;28(6):6695-726. https://doi.org/10.1007/s10639-022-11431-8
14. Mohamed Hashim MA, Tlemsani I, Duncan Matthews R. A sustainable university: Digital transformation and beyond. Education and Information Technologies. 2022 Aug;27(7):8961-96. https://doi.org/10.1007/s10639-022-10968-y
15. Lukianova L, Ovcharuk O. Information Literacy and Digital Inclusion: Challenges of the Modern Information Educational Environment in Ukraine. InFrom Digital Divide to Digital Inclusion: Challenges, Perspectives and Trends in the Development of Digital Competences 2024 Feb 5 (pp. 541-565). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-99-7645-4_25
16. Kabakus AK, Bahcekapili E, Ayaz A. The effect of digital literacy on technology acceptance: An evaluation on administrative staff in higher education. Journal of Information Science. 2023 Mar 15:01655515231160028. https://doi.org/10.1177/01655515231160028
17. Morgan A, Sibson R, Jackson D. Digital demand and digital deficit: conceptualising digital literacy and gauging proficiency among higher education students. Journal of Higher Education Policy and Management. 2022 May 4;44(3):258-75. https://doi.org/10.1080/1360080X.2022.2030275
18. Trevisan LV, Eustachio JH, Dias BG, Filho WL, Pedrozo EÁ. Digital transformation towards sustainability in higher education: state-of-the-art and future research insights. Environment, Development and Sustainability. 2024 Feb;26(2):2789-810. https://doi.org/10.1007/s10668-022-02874-7
19. Marín VI, Castaneda L. Developing digital literacy for teaching and learning. InHandbook of open, distance and digital education 2023 Jan 1 (pp. 1089-1108). Singapore: Springer Nature Singapore.
20. Rahimi AR. A bi-phenomenon analysis to escalate higher educators' competence in developing university students' information literacy (HECDUSIL): The role of language lectures' conceptual and action-oriented digital competencies and skills. Education and Information Technologies. 2024 Apr;29(6):7195-222. https://doi.org/10.1007/s10639-023-12081-0
21. de Obesso MD, Núñez-Canal M, Pérez-Rivero CA. How do students perceive educators' digital competence in higher education?. Technological Forecasting and Social Change. 2023 Mar 1;188:122284. https://doi.org/10.1016/j.techfore.2022.122284
22. Morgan A, Sibson R, Jackson D. Digital demand and digital deficit: conceptualising digital literacy and gauging proficiency among higher education students. Journal of Higher Education Policy and Management. 2022 May 4;44(3):258-75. https://doi.org/10.1080/1360080X.2022.2030275
23. Rahimi AR. Beyond digital competence and language teaching skills: The bi-level factors associated with EFL teachers' 21st-century digital competence to cultivate 21st-century digital skills. Education and Information Technologies. 2024 Jun;29(8):9061-89. https://doi.org/10.1007/s10639-023-12171-z
24. Zhang H, Lee I, Ali S, DiPaola D, Cheng Y, Breazeal C. Integrating ethics and career futures with technical learning to promote AI literacy for middle school students: An explor-

atory study. International Journal of Artificial Intelligence in Education. 2023 Jun;33(2):290-324. https://doi.org/10.1007/s40593-022-00293-3

25. Thornhill-Miller B, Camarda A, Mercier M, Burkhardt JM, Morisseau T, Bourgeois-Bougrine S, Vinchon F, El Hayek S, Augereau-Landais M, Mourey F, Feybesse C. Creativity, critical thinking, communication, and collaboration: assessment, certification, and promotion of 21st century skills for the future of work and education. Journal of Intelligence. 2023 Mar;11(3):54. https://doi.org/10.3390/jintelligence11030054
26. Dilekçi A, Karatay H. The effects of the 21st century skills curriculum on the development of students' creative thinking skills. Thinking skills and creativity. 2023 Mar 1;47:101229. https://doi.org/10.1016/j.tsc.2022.101229
27. Alturki U, Aldraiweesh A. The Factors Influencing 21st Century Skills and Problem-Solving Skills: The Acceptance of Blackboard as Sustainable Education. Sustainability. 2023 Aug 24;15(17):12845. https://doi.org/10.3390/su151712845
28. Suyanto B, Sugihartati R, Egalita N, Mas' udah S, Singgih DS, Sudarso. Digital literacy and survival mechanism of micro-small enterprises in practicing sharing economy. Cogent Social Sciences. 2023 Dec 15;9(2):2245691. https://doi.org/10.1080/23311886.2023.2245691
29. Okoye K, Hussein H, Arrona-Palacios A, Quintero HN, Ortega LO, Sanchez AL, Ortiz EA, Escamilla J, Hosseini S. Impact of digital technologies upon teaching and learning in higher education in Latin America: an outlook on the reach, barriers, and bottlenecks. Education and Information Technologies. 2023 Feb;28(2):2291-360. https://doi.org/10.1007/s10639-022-11214-1
30. Rawal DM. Mapping of school teachers' digital competency in the context of digital infrastructure: a systematic review and empirical study of India. Journal of Professional Capital and Community. 2024 May 3. https://doi.org/10.1108/JPCC-01-2024-0016
31. Ajibo HT, Ene JC. Examining the prospect of online education as drivers of effective and uninterrupted university education in the post-COVID-19 era. Journal of Applied Research in Higher Education. 2024 Jul 9;16(4):988-1000.https://doi.org/10.1108/JARHE-01-2023-0039
32. Acilar A, Sæbø Ø. Towards understanding the gender digital divide: A systematic literature review. Global knowledge, memory and communication. 2023 Feb 20;72(3):233-49. https://doi.org/10.1108/GKMC-09-2021-0147
33. Ng DT, Leung JK, Su J, Ng RC, Chu SK. Teachers' AI digital competencies and twenty-first century skills in the post-pandemic world. Educational technology research and development. 2023 Feb;71(1):137-61. https://doi.org/10.1007/s11423-023-10203-6
34. Gümüş MM, Çakır R, Korkmaz Ö. Investigation of pre-service teachers' sensitivity to cyberbullying, perceptions of digital ethics and awareness of digital data security. Education and Information Technologies. 2023 Nov;28(11):14399-421. https://doi.org/10.1007/s10639-023-11785-7
35. Yusuf A, Pervin N, Román-González M. Generative AI and the future of higher education: a threat to academic integrity or reformation? Evidence from multicultural perspectives. International Journal of Educational Technology in Higher Education. 2024 Mar 25;21(1):21. https://doi.org/10.1186/s41239-024-00453-6
36. Kabakus AK, Bahcekapili E, Ayaz A. The effect of digital literacy on technology acceptance: An evaluation on administrative staff in higher education. Journal of Information Science. 2023 Mar 15:01655515231160028.https://doi.org/10.1177/01655515231160028

37. Carabregu-Vokshi M, Ogruk-Maz G, Yildirim S, Dedaj B, Zeqiri A. 21st century digital skills of higher education students during Covid-19—is it possible to enhance digital skills of higher education students through E-Learning?. Education and Information Technologies. 2024 Jan;29(1):103-37. https://doi.org/10.1007/s10639-023-12232-3
38. Pesovski I, Jolakoski P, Kubincová Z, Herzog M, Trajkovik V. Digital Learning Platforms and Peer Influence: Analysis of Performance and Collaboration. InInternational Symposium on Emerging Technologies for Education 2023 Nov 26 (pp. 195-209). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-97-4246-2_17
39. Kim J. Leading teachers' perspective on teacher-AI collaboration in education. Education and Information Technologies. 2024 May;29(7):8693-724. https://doi.org/10.1007/s10639-023-12109-5
40. Donelan H, Kear K. Online group projects in higher education: persistent challenges and implications for practice. Journal of computing in higher education. 2024 Aug;36(2):435-68. https://doi.org/10.1007/s12528-023-09360-7
41. Gamage KA, Jeyachandran K, Dehideniya SC, Lambert CG, Rennie AE. Online and hybrid teaching effects on graduate attributes: opportunity or cause for concern?. Education Sciences. 2023 Feb 20;13(2):221.https://doi.org/10.3390/educsci13020221