

Data Research-Based Learning for Teachers' Education Program in Pandemic Era

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Abstract

The Covid-19 pandemic forced the education sector to carry out digital transformation, however the enforcement of online learning at Indonesian Higher Education is still experiencing many obstacles. Higher education can use technological advances and knowledge in digital forms such as digital library services and online publication of scientific journals to support new learning environments digitally. Modifying of Research-Based Learning with online data research activities can be used by teachers' education programs as an adaptive effort of distance learning systems. This research accommodated with quasi-experimental method and 50 students were selected with a purposive sampling technique. Online questionnaires were distributed and tested for validity and reliability. Data were analyzed with descriptive and multivariate analysis of variance. Data Research-Based Learning was designed as a group learning and equipped with a template as a guideline for writing articles on the results of data research. Data Research-Based Learning model affects the improvement of 21st-century digital skills and students' academic engagement through exploration of digital content. Data Research-Based Learning provides experiences about research activities where experience is part of knowledge and skill. Learning, thinking, understanding, and connecting data is an essential part of data intelligence in today's significant digital era

Keywords— Research-Based Learning, Teaching with Data, Group Investigation, 21st Century Digital Skills, Academic Engagement.

I. INTRODUCTION

Concern over the outspread of the COVID-19 virus has made governments of the entire country implement strict measures such as lockdowns and social distancing restrictions (Ali, 2020). Closing face-to-face classes both at schools and campuses is the main choice as a response to prevent the wider outspread of the Covid-19 virus in the educational environment. Each educational institution is required to carry out online learning activities. Higher Education also experiencing a period of transition and paradigm shift through technological advances by implementing distance lectures (Aguilera-Hermida, 2020; Ali, 2020; Saravanan, 2020). The adoption of an online learning environment

also poses pedagogical and instructional challenges ranging from the preparation of teaching materials, curriculum, and learning evaluation tools. The closing of face-to-face classes also triggered several negative emotions such as feelings of fear, sadness, and uncertainty (Aguilera-Hermida, 2020; Saravanan, 2020).

Distance learning has been initiated since the 2000s, but the implementation is still experiencing several obstacles and weaknesses, including the inability to practice directly and the process of negotiating personal learning objectives does not occur ('Tanenbaum et al., 1996). Meanwhile, there are still many lecturers and students who use digital technology to do

assimilative tasks as well as to communicate and (Bond et al., 2018; Wilms et al., 2017). In the short term, it is also not an easy thing to monitor and change student learning behavior from face-to-face learning to distance or online learning (Chang & Fang, 2020). The practice of online distance learning has also not been able to meet the expectations of developing countries due to technical infrastructure and monetary problems (Adnan & Anwar, 2020). Although, as time goes by, teachers feel they are starting to be effective in managing students' online behavior (Sokal et al., 2020).

The implementation of online learning or distance learning in Indonesia still experiencing many obstacles, ranging from students who feel unprepared because they do not get socialization, unstable internet networks, relatively expensive internet quota prices, and feelings of dissatisfaction due to online learning being replaced by online learning assignments, as well as lecturer responses that tend to be slow (Giatman et al., 2020; Hidayati & Saputra, 2020). However, students are happy because online lectures eliminate the concept of time and distance using digital platforms such as Google Classrooms, Google Meet, Zoom Meetings, and social media (Hidayati & Saputra, 2020). The complexity of online learning also needs to be supported by adequate communication technology infrastructure, quality digital academic experiences, and encouraging technology-based learning to bridge the gap in the education system before, during, and after the COVID-19 pandemic (Mishra et al., 2020).

Data from the Indonesian Central Statistics Agency shows that during online learning there is an increase intensity of the use of cellular phones, computers, and the internet among students, but the proportion of Information and Communication Technology (ICT) skills among adolescents and adults only reached 58.22 percent in 2019 and 64.26 percent in 2020 (Statistik, 2020). It can be said that at the time of distance learning 21st-century digital skills are still low. The low 21st-century digital skills are caused by several factors such as low digital

skills and a lack of understanding of the benefits of information technology or digital literacy (James, 2021). Digital skills or the ability to take advantage of information and communication technology support are important to expand the knowledge and skills needed in the labor market and social participation (Pagani et al., 2016). Access and motivation also mediate the relationship between digital skills and engagement in technology use (van Deursen et al., 2014). In addition, the low level of digital skills is also caused because students are trapped by perceptions about the use of ICT in terms of nouns (PowerPoint, Zoom, or Google Classroom) and not in verbs (presenting, sharing, and communicating) (Pheeraphan, 2013). Digital skills that are influenced by the ability to use ICT in this case are needed not only when studying but also in careers and lifelong learning.

Meanwhile, the low level of student academic activity in online learning can be caused by the lack of face-to-face interaction with instructors, problems related to response time, and the absence of social activities such as traditional classes that affect the academic activity and academic success (Adnan & Anwar, 2020). However, students feel happy because online lectures eliminate the concept of time and distance with the existence of a digital platform (Hidayati & Saputra, 2020). Other challenges in implementing online learning are ways to maintain online class order, arrange class discussions and online communication, student involvement, and feedback in online discussions to mobilize student learning attention (Chang & Fang, 2020). Distance learning during the Covid-19 pandemic also poses challenges in the form of the inability of students to be actively involved digitally in equal portions (Iivari et al., 2020). Students who have low levels of academic activity tend to have less initiative that can increase learning opportunities, give up easily, are sad, hopeless, and apathetic (Skinner et al., 2009).

Meanwhile, the level of research in Indonesia is still low compared to other countries globally

and ASEAN due to the small number of researchers and publications, even though there is an upward trend in publications (Gerintya, 2019; UNESCO, 2021). One of the efforts to increase scientific publication by Higher Education is by integrating research into learning (Brew, 2001, 2002, 2003, 2006, 2011; Brew & Boud, 1995) so that lecturers and students can collaborate and motivate students (Benavides et al., 2020). Due to global competitiveness, which needs 21st-century abilities such as active learning, critical reflection, and problem-solving, teacher education programs also require the sort of education and competences supplied through research activities to improve knowledge as potential instructors. (Afdal & Spernes, 2018). 21st-century skills (Niemi & Nevgi, 2014) require instructors to keep their curricula and teaching methods up to date in order to position students as knowledge creators rather than information receivers. (Afdal & Spernes, 2018). Attitudes, Students' cognitive engagement and academic achievement are influenced by motivation, self-efficacy, and technology. [11]. Designing and creating a curriculum that can sustain students' progress from beginners to experts in the research domain is not an easy task (Ifenthaler & Gosper, 2014). Therefore, digital data research habituation is carried out to develop 21st-century digital skills and students' academic engagement.

One of the courses that can raise awareness of digital skills is digital economy courses. Digital Economy is a course that examines economic and business activities based on digital technology, including knowledge of digital business management and analysis ('Chaffey, 2009). Furthermore, the digital economy is an economic phenomenon that can reduce cost of search, cost of replication, cost of transit, cost of tracking, and cost of verification (Goldfarb & Tucker, 2019). Internet support and digital technology using digital network technology combined with open licenses can be utilized for educational activities (Weller, n.d.). Digital economy learning during the online learning period at the UNS Economic Education

Program itself has not taken advantage of the availability of digital data for students to explore. The urgency of using ICT does not only affect economic activity, but has also entered into production, finance, research, education, and even daily life activities (Babkina & Skotarenko, 2018). Advances in technology and the availability of knowledge in digital form can be utilized by Higher Education to support a new digital learning environment (Angeloni, 2020; Watanabe & Naveed, 2017). Moreover, the availability of digital literacy is important to support the development of digital skills, especially digital information (Saikkonen & Kaarakainen, 2021). By providing a variety of digital references, digital libraries and online scientific journal publishing play a significant role as instructional services., in addition to supporting the development of digital literacy and skills through the process of browsing digital content (Pun, 2015).

II. RELATED STUDIES

Research-Based Learning

Since the 1970s, research has been an element of German students' learning courses (Brew & Saunders, 2020), and it has evolved into a reform movement centered on the Bologna Declaration. (European Ministers in charge of Higher Education, 1999) to promote the competitiveness of higher education in Europe to the rapid changes in the reality of knowledge (Brew, 2006; Brew & Boud, 1995; Griffiths, 2004; Jenkins et al., 1998). RBL is a learning approach that incorporates the research process into learning activities such as search, inquiry, discovery, problem-solving, decision-making, and academic journal writing (Afdal & Spernes, 2018; Brew & Saunders, 2020; Healey & Jenkins, 2009). Research-based learning is a teaching style that promotes the application of reasoning power (Schunk, 2014), challenges creativity and intellectuality (Brew, 2003), and cooperation between instructors and students as a form of accountability for learning quality (Fielding & Bragg, 2003; Healey & Jenkins, 2009; Kincheloe, J & Steinberg, S, 1998). The RBL approach has an impact on learning

outcomes because it encourages students to build personal talents and critical thinking abilities (Brew & Saunders, 2020).

The RBL paradigm is divided into four quadrants depending on engagement and methodologies (Healey & Jenkins, 2009), including (1) research-led; (2) research-oriented; (3) research-tutored; and (4) research-based (Healey & Jenkins, 2009). To engage students in research conversations and research activities, this study combines the research-based and research-tutored quadrants (Healey & Jenkins, 2009). Varied types of participation will have different effects on academic performance (Brew & Mantai, 2017). Critical thinking abilities, analytical skills, and personal qualities are all emphasized in process and content methods that focus on student engagement. (Brew & Saunders, 2020). In implementing RBL, It must consider resources, infrastructure, and learning objectives in order to create learning implementation strategies that allow critical reflection. (Brew & Boud, 1995; Brew & Mantai, 2017). The factors that influence student perceptions also need to be considered by teachers in implementing RBL, including motivation, reflection, participation, and student understanding of current research (Visser-Wijnveen et al., 2016).

RBL provides opportunities for students to explore because there are student guidance and autonomy activities that support the Creativity growth, critical thinking skills improvement via class interactions, and a process of reflection and feedback that increases research knowledge (Brew & Saunders, 2020). RBL model requires students to investigate evidence in the context of concluding (Niemi & Nevgi, 2014), and making a more collaborative, problem-solving-oriented learning approach that leads to autonomous and peer learning (Brew & Boud, 1995). The implementation of RBL positions students as knowledge creators through active learning, critical reflection, and problem-solving based on which encourages the development of 21st-century skills (Afdal & Spernes, 2018). Furthermore, RBL adoption allows for the development of dynamic learning

evaluation tools, allowing students' learning outcomes to be assessed in ways other than remembering facts or concepts. (Brew & Saunders, 2020; Koh et al., 2014).

Teaching with Data

Teaching with data provides a learning experience through by paying attention to theoretical underpinnings and practical methodologies in empirical research (Wuthisatian & Thanetsunthorn, 2019). Activities by collecting and interpreting data are helpful for bridging the gap between classroom learning and the natural world (Zhuang, 2011). To obtain conclusions, students must apply certain analytical tools and procedures as part of the teaching with data strategy. The information used must be based on current events. such as magazines, newspapers, radio broadcasts, television, and social media (Ray, 2018). Teaching with data can develop and improve communication skills (verbal, written, and graphic) (Zhuang, 2011). The concept of teaching with data directs students to find alternative solutions, not just getting right or wrong answers (Ray, 2018). Teaching with data can bridge between theory and empirical evidence (Wuthisatian & Thanetsunthorn, 2019). Collaboration, communication, creativity, and critical thinking abilities may all be developed through interactive education through classroom projects (Wuthisatian & Thanetsunthorn, 2019). Teaching using data enables students to be aware of local and global concerns, to become educated citizens, to model conflict and resolution scenarios, and to improve their reading, critical thinking, and writing abilities. (Zhuang, 2011).

Critical thinking abilities are required for collecting data and transforming data into information, however this process is not covered in the educational process (Ackoff, 1999). A fact or statement about an occurrence that has nothing to do with anything else is called data (Bellinger et al., 2003). Understanding of the current relationship and the potential of cause-and-effect relationships between data refer information that can provide

predictive value or knowledge with basic principles systemically called wisdom (Bellinger et al., 2003). In the context of learning, humans must perform an orderly selection of data physically then analyzed it in a cognitive way to obtain the important information as the fundamental belief of knowledge that is used as consideration in making a justification (Rowley, 2007). The ability to study, think, and comprehend is referred to as intelligence, but in modern society, humans also need to be connected (communication) (Sun & Huo, 2020). Hierarchically arranged Intelligence is built on the foundations of data, information, knowledge, experience, and wisdom (DIKEW) (e.g. human intelligence, cognitive intelligence, artificial intelligence, and machine intelligence) (Rowley, 2007; Sun & Huo, 2020). Experience as complement to the previous taxonomy of knowledge (e.g. (Ackoff, 1999; Zeleny, 1987) because the experience is a knowledge and skill acquired in the past or through social practice over a while (Sun & Huo, 2020). Learning and thinking from data in understanding the relationship between data is part of data intelligence and plays a vital role in the current era of big data (Sun & Huo, 2020).

21st-Century Digital Skills

This study was employed the 21st-century digital skills developed by (van Laar et al., 2019) then adjusted to the concept of student learning. The concept of 21st-century skills originated from the rapidly increasing development of digital technology and is used by the younger generation (Binkley et al., 2014). Educational transformation must facilitate the development of higher-order thinking skills, flexibility in problem-solving, effective communication, and virtual collaboration required in work and life activities in the future (Binkley et al., 2014). Meanwhile, the current labor market wants a workforce with digital knowledge and skills to create and distribute ideas or information (Binkley et al., 2014; van Laar et al., 2019) as individuals need to develop 21st-century skills to achieve higher

levels of progressivity and deeper levels of learning from the existing knowledge base (Binkley et al., 2014). Factors of personal potential, motivation influence 21st-century digital skills, and social abilities in using information and communication technology (van Laar et al., 2019).

There are six dimensions of 21st-century digital skills (van Laar et al., 2019), namely (1) digital information skills with digital information management and digital information evaluation indicators; (2) digital communication skills as the ability to digitally distribute information that reflects the best way of presenting information content to a particular audience, so the audience of online interactions can grasp the meaning conveyed through media or digital communication tools; (3) digital collaboration skills as the ability to work together effectively and respectfully among group members to achieve a common goal; (4) digital critical thinking skills as the ability to objectively make judgments based on information from various perspectives so that a solid argument is obtained; (5) digital creative skills as the ability to use online media to create creative digital content; and (6) digital problem-solving skills as the ability to use various online tools and media needed to reach a satisfactory decision or solution.

Academic Engagement

Several studies have validated academic engagement as a reflection of student performance, more students actively involved in learning, they have better performance to achieve optimal learning achievement (Chukwuorji et al., 2018; Reeve & Tseng, 2011). Academic engagement becomes the focus of many researchers because it relates to thinking characterized by three dimensions: understanding, enthusiasm, and dedication (Schaufeli et al., 2002). Academic engagement is the initiation of students in trying, acting, and being diligent when on campus, including creating an emotional atmosphere that supports the continuity of the learning process (Skinner et al., 2009). Academic engagement shows

active involvement and reflected in every behavior, emotional, cognitive, and agentic (Reeve & Tseng, 2011). The student academic engagement shows that there are student initiations in trying, acting, and being diligent while studying in college, including efforts to create an emotional atmosphere that can support the continuity of the learning process in a positive direction. The currently developing educational orientation is targeted to increase student academic engagement (Reeve & Tseng, 2011), includes (1) behavioral engagement; (2) cognitive engagement; (3) emotional engagement; and (4) agentic engagement.

Behavioral engagement is a positive behavior that appeared by students while in the campus environment. Students who are engaged will show disciplined behavior, be present on time, actively participate in assignments, and have self-preparation for attending lectures (Fredricks et al., 2004; Skinner et al., 2009). In contrast to students who tend to be passive, they will show truancy behavior, come to class late, passive in doing assignments, and are less prepared for attending lectures. Cognitive engagement is a psychological investment in learning (Fredricks et al., 2004). The cognitively active student can self-regulation to gain knowledge strategically through changing the learning strategies if they encounter problems in understanding material, such as summarizing, exercising, looking for other reference sources, and having discussions with friends (Mih et al., 2015). In contrast, students who are not active tend only to accept material delivered by lecturers. Emotional engagement is a student affective reaction including interest, enthusiasm, happiness, sadness, and anxiety towards the school and teaching staff (Fredricks et al., 2004; Reeve & Tseng, 2011; Skinner et al., 2009). Students who are enthusiastic and happy will feel excited when attending lectures. In contrast, students who feel sad and anxious will tend to be moody, inactive, and not excited to participate in lectures. Agentic engagement is a student's constructive contribution to the instruction received (Reeve & Tseng, 2011). Students are learning agents who must respond

to the lecture instructions, dare to offer their preferences or suggestion as a form of reciprocal communication with the lecturer, and ask for help to get learning opportunities when find out of difficulties to get references. In contrast, students who are not active tend to be silent and do not dare to express ideas or only follow the lecturer's words without finding other references.

III. RESEARCH METHOD

This research focuses on the effectiveness of data research-based learning model so the quasi-experimental method is used with the pretest-posttest control group design (Ho, 2006; Sukmadinata, 2017). The quasi-experimental method used to determine the efficacy of data research-based learning models compared to learning models commonly used in lectures (Sukmadinata, 2017).

Participants

The population in this study were undergraduate students of economic education for generation years 2018. The sampling technique used was purposive sampling with the criteria for students enrolled in digital economy courses. Digital economics is an elective course in the new curriculum structure and student's choice considered to relevant field of work in the future by considering factors: ideals, top-level student references, fears, motivations, and challenges (Sangka & Muchsini, 2018). The sample used was 50 students who were divided into two groups with 25 students each as the experimental and control groups. The experimental group used research-based learning model with online research activities and the control group with discovery learning. The lecture materials used in the two groups among others: digital business environment, digital business strategy, and the concept of supply chain management in digital business.

IV. DATA COLLECTION AND ANALYSIS

Data collection was carried out using a Likert scale questionnaire instrument which online distributed to students at the pretest and posttest sessions. The pretest is given before learning begins at the first meeting and the posttest is given after the third meeting is over. Data analysis was performed using MANOVA with

the IBM-SPSS 25 application. The MANOVA test is an extension of the analysis of variance that allows testing of more than one independent variable on two or more dependent variables together (Santoso, 2018). The following table presents research instruments that have previously been tested for validity and reliability prerequisites.

The Scale

Table 1. Instruments of 21st Century Digital Skills and Academic Engagement

Variables	Dimensions	Indicators	Questions Item	Sources
21 st Century Digital Skills (21 st CDS)	Information Digital	Information management, digital information evaluation	20 items	(van Laar et al., 2019)
	Communication Digital	Expressiveness, relationships, sharing content		
	Collaboration Digital	Work effectiveness, mutual respect		
	Critical Thinking Digital	Ability to assess information, communication-based on data reflection		
	Creative Digital	Creating creative online content, generating ideas from various online sources		
Academic Engagement (EA)	Problem Solving Digital	Analysis problems using ICT, share knowledge with others	18 items	(Reeve & Tseng, 2011)
	Behavioural Engagement	Preparation for college, attendance, discipline, participation in academic work		
	Cognitive Engagement	Actively asking questions, clarifying ideas, persevering, cognitive flexibility, learning strategies		
	Emotional Engagement	Enthusiastic, bored, anxious		
	Agentic Engagement	Initiative asking, being open, expressing preferences, giving suggestions		

The data on 21st-century digital skills and academic engagement in both the experimental and control groups have a significance value > 0.05 , so it can be said that the data usually is typically distributed and has a significance value >0.05 to be stated that the data is

homogeneous. Also, it is supported by Box's Test of Equality of Covariance Matrices value of 2.518 with a sig level of 0.493. Students in the experimental group received assignment instructions and a template for writing data research results to train 'students' writing skills

so that students were familiar with the rules of writing scientific articles. With the covid-19 pandemic, learning is carried out online by ensuring that learning can train 21st-century

digital skills and facilitate student academic activity. The implementation of the group investigation learning model based on research data is presented in the table as follows:

Table 2. Student Activities in Group of Data Research-Based Learning Model

Meeting	Student Activities	Student Achievement	Media/Tools
First Meeting	Apperception Phase: Students listen to information conveyed by lecturers in the form of competency standards, basic essential competencies, indicators, learning objectives, and material topics (digital business environment, digital business strategy, and supply chain management concepts in digital business).	Students can understand the learning objectives to be achieved in digital business environment materials, digital business strategies, and the concept of supply chain management in digital business.	Zoom Meeting
	Reaction Exploration Phase: Convey arguments or ideas and ask questions if there are concepts that have not been understood	Students receive feedback and understand the current scientific context according to the learning material.	Zoom Meeting
	The organizing phase of learning: Form study groups, choose topics, and divide assignments to each member. In this section, students fill out the online questionnaires.	Students apply democratic principles in the context of learning, from choosing topics to planning cooperation.	Zoom Meeting, Google Form
Second Meeting	Data Research, Analysis, and Synthesis Phases: Search, process, interpret, and present data in the form of articles	Students obtain data from various sources and produce a simple research article.	Zoom Meeting, Google Classroom, Media Social
Third Meeting	Evaluation Phase of Data Research Results: Present the results of data research and discuss through zoom meetings	Students get feedback from other groups and lecturers in both scientific and systematic writing.	Zoom Meeting, Google Classroom
	Reflection and Reward Phase: Students and lecturers conclude the learning. Students assigned to fill out the post-test questionnaires.	Students can evaluate the learning process achieved and decide what stages of research need to be done again after receiving feedback.	Zoom Meeting, Google Form

V. FINDINGS



Figure 1. Histogram comparing of before and after treatment (a) 21-Century Digital Skills, (b) Academic Engagement.

21st-century digital skills and students' academic engagement in the experimental group based on the pre-test results were still in the deficient category. After receiving treatment for implementing a group data research-based learning model, there was an increase based on the average post-test results of 21st-century digital skills and student academic engagement. Figure 1 above shows the histogram of the mean increase in the two variables descriptively, even though the increase is still in the moderate category. Further tests are needed to determine how much influence the data research-based learning model has on digital skills in the 21st century and student academic engagement through the multivariate analysis of variance (MANOVA) statistical test.

Table 3. MANOVA Test Results

Effect	Sig.	Partial Eta Squared
Pillai's Trace	.000	.353
Wilks' Lambda	.000	.353
Hotelling's Trace	.000	.353
Roy's Largest Root	.000	.353

Multivariate analysis (MANOVA) was conducted to test data research-based learning models' effectiveness on 21st-century digital skills and academic engagement. The MANOVA test results show that the F Pillai's

Trace, Wilk Lambda, Hotelling Trace, Roy's Largest Root more negligible significance than 0.05 so that the data research-based learning model has a significant effect on digital skills and student academic engagement. The effect size of the influence of the independent variable on the dependent variable can be seen from the intercept table in the partial eta squared column with a value of 0.353 which means that the data research-based learning model simultaneously has a significant effect on the score of digital skills and student academic engagement by 35.3%. Meanwhile, the effect of the univariate data research-based learning model on digital skills and academic engagement can be seen through the test of between-subjects effect table as follows:

Table 4. The Effect of Data Research-Based Learning Models on 21st-Century Digital Skills and Academic Engagement

Test of between-subject effect	F	Sig.	Partial Eta Squared
21st-century digital skills	12.819	.001	.211
Academic Engagement	10.932	.002	.186

The relationship between data research-based learning models on 21st-century digital skills with an F value of 12.819 at a significance level of 0.001. The findings show that the univariate data research-based learning model affects

digital skills. Meanwhile, the data research-based learning model affects on academic engagement with an F value of 10.932 with a significance level of 0.002. Eta Squared Partial Column shows that the variance in 21st-century digital skills is 0.211 (21.10%) and 0.186 academic engagement (18.60%).

Table 5. Gain Scores for 21st-Century Digital Skills and Academic Engagement

Variables	Gain Score	
	Experiment	Control
21st-century digital skills	0,41	0,24
Academic Engagement	0,41	0,29
Criteria	Moderate	Poor

Table 5 shows that the gain score of the experimental group is greater than the control group so that the data research-based learning model affects improving 21st-century digital skills and academic engagement. The gain value of 21st-century digital skills and academic engagement of the experimental group of 0.41 is in the moderate category. The gain values of 21st-century digital skills and academic engagement of the control group are 0.24 and 0.29 are in a low-categories.

VI. RESULTS AND DISCUSSION

The RBL model introduce students to research activities and is effectively used as a learning method that focuses on the empirical research literature (Afdal & Spernes, 2018). This article discusses modifying the RBL model as data research-based learning (DRBL) through digital means to adopt distance learning activities during the Covid-19 pandemic. In this study, the implementation of DRBL was carried out in groups online using the Google Classroom platform, WhatsApp group, Zoom Meeting, and Google Forms. Students have instructed a guide in carrying out DRBL activities and are free to choose the platform used for communication and collaboration, such as WhatsApp groups. Students conduct data research through browsing free digital content or using a university guest user account. The data research

result written following the writing template and then uploaded on the Google Classroom platform for digital economy courses. Evaluation of research results is carried out by organizing students to make presentations and discussions through the Zoom meeting platform.

A research-oriented learning approach helps equip the skills needed by students in the 21st-century field of work by utilizing learning experiences so that students can find independent learning systems (Ifenthaler & Gosper, 2014). An approach through reading data based on a systematic research process allows students to integrate knowledge with professional practice (van Ingen & Ariew, 2015). Learning that is oriented towards research activities is a learning tool that bridges theoretical perspectives with empirical data because there is a discussion process that results in findings from analytical activities (Afdal & Spernes, 2018). The use of the shared learning method is carried out because it is instructional utilized successfully to enhance student attitudes and behavior so that students from all ethnic origins may share their knowledge and experiences (Slavin, 1989, 2009). Israel, West Germany, the Netherlands, Canada, and Nigeria have all adopted the Group Investigation (GI) approach to great success. succeeded in improving 'students' accomplishment, and it's linked to social learning in a favorable way. (Slavin, 1989) and promotes academic engagement (Onwuegbuzie et al., 2009). Also, Because it combines task specialization in small groups with investigation activities on specialized themes, the GI method is an effective learning technique (Mitchell et al., 2008). Through planning activities, debating, asking questions or difficulties, and analyzing them to give answers, the GI approach helps pupils to think critically. (Asyari et al., 2015). The GI method can be used in higher education which is oriented towards analytic activities that require As a learning aid, guidance (Baki, 2010). Inquiry-based learning in a group setting (Lämsä et al., 2020) which is carried out with

asynchronous online discussion can be optimized by writing the investigation result. DRBL as a research-oriented learning redesign accommodates the development of 21st-century digital skills through digital content exploration activities that require critical thinking skills, information management, and information evaluation so that students can acquire knowledge and skills that approach and reflect on activities research in a systematic manner (Afdal & Spernes, 2018). DRBL helps pupils completely to uncover material that may be examined based on their writing demands (similarity in topics or chronology of time) to give predicting value or conclusion value. The development of digital skills is a critical necessity that may assist students with streaming data in real-time, discovering insights in data, and then analyzing them for decision-making reasons (Igor, D., & Aleksandr, 2020). Students are expected to retain up-to-date information available online, such as scientific articles, journals, and digital libraries, through data research activities. Aligning skill development through RBL or research projects helps students to directly connect theory and practice. (Ifenthaler & Gosper, 2014). Students are given assignment instructions and writing templates to help them develop their abilities in producing research results that adhere to academic criteria. Research-based learning enhances student autonomy by allowing them to study independently. (Brew & Saunders, 2020). DRBL also demands the growth of student academic involvement through digital communication medium and digital collaboration to solve an issue creatively, so that students value the capacity to reflect and cooperate with others more and more. (van Ingen & Ariew, 2015). DRBL activities are designed in groups to exchange knowledge because research activities are new to Students' comprehension is influenced by cultural characteristics, emotional intelligence, leadership skills, conduct, and student information sharing, all of which affect team success (Jamshed & Majeed, 2019). Peer learning allows students to interact with one

another and feel more comfortable asking questions of their peers rather of the teacher. Although group learning promotes social laziness, the expectation that other members of the group will assume responsibilities (Chou & Ramser, 2019). Students who are already feeling ignored are more likely to be passive in class or the group learning process. Learning motivation reflects performance and impacts students' academic and social adaptation (Olivier et al., 2018). Lecturers and researchers must recognize that learning must be organized to meet students' preparedness to conduct professional research activities. (Afdal & Spernes, 2018). As a result, students are required to publish writing improvements using Google Classroom media at each meeting so that the lecturer may watch them.

Overall, students in the experimental group showed better performance than those in the control group. Even though, the effect of the DRBL model was not much different from the research of RBL by Afdal & Spernes [19]. Based on the research writing report and discussion, the student's performance are still limited to describing a theory in their own words (paraphrase) and monocausal relationships that are not yet complex (Ifenthaler & Gosper, 2014). The DRBL model simultaneously has a significant effect on students' 21-century digital skills and academic engagement by 35.3% and variants of 21st-century digital skills of 0.211 (21.1%) and 0.186 academic engagement (18.6%). Meanwhile, the gain value of 21st-century digital skills and student academic engagement of the experimental group with each score of 0.41 has increased from the low to medium category.

These findings strengthen the effectiveness of the DRBL model even though the digital implementation still requires further research. The impact of the data research-based learning model on academic engagement is relatively smaller, and its indicating that the online ethos of students through digital means is still relatively low (Xiao, 2019). Students personally still rarely use web-based software systems

(e.g., Turnitin test) that can measure the level of plagiarism of scientific papers. Whereas the level of plagiarism reflects academic integrity and can be an indicator of the assessment of writing assignments (Ng, 2020). Students can exercise critical thinking skills in written material, writing systems, and citations by using tools that can quantify the extent of plagiarism as an indicator of learning evaluation (Johari et al., 2015; Li & Li, 2017). Students will be more cautious in their citations and must be meticulous in citing every documented reference source. Avoiding plagiarism can also help students learn about and respect the ownership rights of others' ideas or copyrights, which are protected by laws and regulations (Vie, 2013).

Some of the strategies that students can take to increase academic engagement include increasing self-efficacy, establishing good relationships with the academic community to create a balance between academic and social abilities, finding out the relevance of course material to career or work, participating in discussion activities, debating between students, observation or research, interactive presentations, and portfolios (Alrashidi et al., 2016). Students can also change learning strategies if they encounter problems in understanding material, such as summarizing, training, looking for other reference sources, and discussing with friends (Mih et al., 2015). The data research-based learning model can direct students to do simple research based on digitally available data to encourage students to create knowledge through more complex research activities. Learning-oriented research activities in undergraduate education programs require complex processes involving many components, parallel processes, and longitudinal perspectives (Afdal & Spernes, 2018). More than that, proving learning that is oriented towards research activities as a learning approach still has to be done to consider the needs and preferences of learners by accommodating the types of research options and opportunities (Afdal & Spernes, 2018). Early in instilling a research-based learning

model can encourage students to be more active as knowledge creators (Walkington, 2015).

This study finds the effectiveness of a learning model oriented towards data research activities with a group learning approach, although on small case. RBL naturally incorporates the research process into learning, encompassing tasks such as searching, inquiry, discovery, problem-solving, decision-making, and academic journal writing. Research-based learning with online data research activities (Data Research-Based Learning) aims to train students to learn, think, understand, and connect data. The exploration of digital content or digital data can help to drill the student's 21st-century digital skills (digital information, digital communication, digital collaboration, digital critical thinking, digital creativity, and digital problem solving). Aspects of knowledge, skills, and experience impact the academic engagement of students when attending distance lectures. The DRBL stages include (1) apperception; (2) reaction exploration; (3) organizing learning; (4) research, analysis, and synthesis; (5) evaluation of data research results; and (6) reflection and reward. DRBL in this study is still limited to training 'students' abilities in describing a theory with their own words (paraphrase) and monocausal relationships because the implementation is only limited to one learning indicator. Still, there were no students who took the initiative to perform statistical data analysis in their writing report. Therefore, further research of DRBL is needed for affirmation and wider evidence.

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