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Enhancing Student Creativity Through pjbl "diskon babe" Using Reused Computer Peripherals

Maryuli Darmawan
SMKN 3 Yogyakarta

Email: maryulidarmawan07@guru.smk.belajar.id

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ABSTRACT

This classroom action research examined the use of Project-Based Learning (PjBL) through the "Diskon Babe" strategy, which combines discussion, consultation, and the reuse of discarded computer peripherals to support creativity in vocational computer learning. The participants were 32 Grade X Computer and Network Engineering students at SMKN 3 Yogyakarta. The study followed two action-research cycles consisting of planning, action, observation, and reflection. Creativity was observed through five indicators: analytical problem solving, creating, producing a product, expressing ideas in discussion, and consultation for problem confirmation. Mean creativity attainment increased from 71% in Cycle 1 to 77% in Cycle 2, both within the study's "good" category. The strongest Cycle 2 indicators were product creation (94%) and creating ability (86%), while consultation decreased from 63% to 53%. Reused peripherals also reduced the reported material cost from IDR 2,225,000 for new components to IDR 80,000 for used components, equivalent to approximately 96.4% cost efficiency. The findings indicate that a reuse-oriented PjBL design can provide a practical context for creativity, collaboration, and environmental awareness in vocational education. Because the study used classroom action research without a comparison group, the observed changes should be interpreted as classroom improvement rather than causal effects.

Keywords: classroom action research; creativity; electronic waste; project-based learning; vocational education

INTRODUCTION

Vocational education is expected to connect technical competence with problem solving, creativity, collaboration, and authentic production. Project-based learning is particularly compatible with this expectation because students investigate meaningful problems and produce tangible artifacts rather than merely reproduce declarative knowledge (Bell, 2010; Blumenfeld et al., 1991; Kokotsaki et al., 2016; Krajcik & Blumenfeld, 2006; Thomas, 2000). Meta-analytic and review evidence further suggests that well-designed PjBL can improve academic achievement, motivation, collaboration, and higher-order thinking when projects are appropriately scaffolded (Chen & Yang, 2019; Guo et al., 2020; Holm, 2011; Condliffe et al., 2017; Zhang & Ma, 2023).

Creativity is central to contemporary technical learning because students must generate, test, revise, and communicate solutions under real constraints. Research on creativity emphasizes divergent idea generation, domain knowledge, motivation, iterative refinement, and supportive learning environments

(Amabile, 2012; Beghetto & Kaufman, 2014; Cropley, 2001; Hennessey & Amabile, 2010; Runco & Acar, 2012; Sawyer, 2012). In engineering and technology education, design-oriented tasks can make creativity observable through problem framing, prototyping, collaboration, and product improvement (Daly et al., 2012; Doppelt, 2009; Henriksen et al., 2017; Lucas et al., 2013).

The source classroom context reported limited student initiative in computer-assembly learning and a need to make abstract knowledge of peripherals more concrete. The class also operated within an environmentally oriented school context, creating an opportunity to combine technical learning with reuse of damaged peripherals. Such reuse is educationally relevant because electronic waste is a rapidly growing sustainability challenge, and circular-economy approaches emphasize extending material value through reuse, repair, refurbishment, and recycling (Baldé et al., 2024; Forti et al., 2020; Ghisellini et al., 2016; Kirchherr et al., 2017; Korhonen et al., 2018). Education for sustainable development similarly calls for learning designs that connect knowledge, action, responsibility, and real-world problems (Leicht et al., 2018; Lozano et al., 2017; Wiek et al., 2011).

Accordingly, this study examined whether the PjBL "Diskon Babe" strategy—discussion and consultation using reused computer peripherals—could improve students' observed creativity and make learning resources more economical. The research questions focused on changes in creativity indicators across two action-research cycles and on the practical efficiency of using discarded peripherals as project materials.

LITERATURE REVIEW

Project-Based Learning in Vocational and Technology Education

PjBL organizes learning around an extended task that culminates in a product, performance, or solution. Its effectiveness depends on authenticity, learner agency, collaboration, formative feedback, and explicit facilitation rather than minimally guided discovery (Hmelo-Silver et al., 2007; Kirschner et al., 2006; Larmer et al., 2015; Scarbrough et al., 2004). Technology-rich projects can strengthen computational and design practices when students are required to plan, build, troubleshoot, explain, and revise artifacts (Doppelt, 2009; Krajcik & Shin, 2014; Lou et al., 2017; Tseng et al., 2013). In vocational contexts, authentic projects also support transfer between school knowledge and workplace practices (Billett, 2011; Misbah et al., 2020; Sudjimat et al., 2020).

Creativity, Collaboration, and Feedback

Creativity develops through cycles of idea generation, evaluation, and revision. Classroom environments that tolerate productive failure, support autonomy, and provide useful feedback are more conducive to creative engagement (Beghetto, 2019; Henriksen et al., 2017; Hennessey & Amabile, 2010).

Collaborative learning can expand the range of ideas available to a group, although productive collaboration requires participation structures and guidance (Johnson & Johnson, 2009; Laal & Ghodsi, 2012; van Leeuwen & Janssen, 2019). Formative feedback and consultation are therefore important because they help learners compare current performance with criteria and identify next steps (Hattie & Timperley, 2007; Panadero et al., 2018; Wisniewski et al., 2020).

Reuse, E-Waste, and Sustainable Learning

Reusing obsolete computer parts can make sustainability visible through direct material practice. Circular-economy research distinguishes reuse from end-of-life recycling because reuse preserves more of the product's embedded value (Geissdoerfer et al., 2017; Kirchherr et al., 2017). E-waste studies also emphasize environmental and health risks from uncontrolled disposal and the need for improved collection, repair, and material recovery (Kiddee et al., 2013; Perkins et al., 2014; Parajuly et al., 2019). When incorporated into project learning, discarded components can become boundary objects linking technical knowledge, cost awareness, and environmental responsibility.

Recent and established studies likewise show that project-based and design-centered learning can support motivation, problem solving, creativity, and STEM engagement across secondary and technical settings (Chiang & Lee, 2016; Han et al., 2015; Kaldi et al., 2011; Musa et al., 2012; Ralph, 2016; Sasson et al., 2018). In parallel, e-waste scholarship highlights the scale, material value, and management challenges of discarded electronics, reinforcing the relevance of reuse-oriented educational projects (Borthakur & Govind, 2017; Cucchiella et al., 2015; Kumar et al., 2017; Robinson, 2009; Song & Li, 2014; Zeng et al., 2017).

METHODS

Design and Participants

The study used classroom action research based on the cyclical logic of planning, action, observation, and reflection. Thirty-two Grade X students in the Computer and Network Engineering program at SMKN 3 Yogyakarta participated. Two cycles were implemented. Cycle 1 focused on input-output peripherals such as mice, keyboards, and printers; Cycle 2 extended the activity to storage devices such as flash drives and internal and external hard disks. The intervention was the PjBL "Diskon Babe" strategy, in which students discussed peripheral functions, consulted the teacher when difficulties emerged, and transformed reused components into an informational computer-peripheral display board.

Creativity Indicators and Data Analysis

Observation sheets were used to record five indicators defined in the source study. Each indicator was expressed as the proportion of the 32 students demonstrating the targeted behavior. The source classification was: below 50% = very low; 50–60% = low; 60–70% = sufficient; 70–80% = good; and above 80% = very good. Descriptive comparisons were made between cycles. No inferential statistical test was reported, so interpretation is limited to observed classroom change.

Table 1. Creativity indicators used in the classroom action research

No.	Indicator	Observed activity
1	Analytical intelligence	Problem-solving ability
2	Creative aspect	Ability to create
3	Practical aspect	Ability to produce a product
4	Discussion	Ability to express opinions
5	Consultation	Confirmation of problem solving

RESULTS AND DISCUSSION

Changes in Creativity Indicators

Table 2. Creativity attainment across the two action-research cycles

Indicator	Cycle 1	Cycle 2	Change
Problem solving	56%	69%	+13 pp
Creating	81%	86%	+5 pp
Producing a product	100%	94%	−6 pp
Expressing opinions	53%	78%	+25 pp
Consultation	63%	53%	−10 pp
Mean	71%	77%	+6 pp

The class mean increased from 71% in Cycle 1 to 77% in Cycle 2. The largest positive change occurred in expressing opinions during discussion (+25 percentage points), followed by problem solving (+13 points). Creating ability rose from 81% to 86%. Product production remained very high despite decreasing from 100% to 94%, whereas consultation declined from 63% to 53%. Thus, the overall improvement was not uniform across indicators. The decline in consultation is important because it cautions against interpreting the 77% mean as evidence that every dimension of creativity improved.

The observed pattern is compatible with PjBL literature describing projects as contexts for iterative problem solving, communication, and artifact creation (Bell, 2010; Chen & Yang, 2019; Guo et al., 2020; Kokotsaki et al., 2016). The particularly large gain in expressing opinions may reflect the discussion-centered structure of the project. At the same time, lower consultation in Cycle 2 may indicate greater independence, reduced help-seeking, or insufficient use of teacher support; the available data cannot distinguish among these explanations. Research on feedback and collaborative regulation suggests that

consultation should remain intentionally structured even when learner autonomy increases (Panadero et al., 2018; van Leeuwen & Janssen, 2019; Wisniewski et al., 2020).

Resource Efficiency and Sustainability

Table 3. Reported price comparison for new and reused computer peripherals

Peripheral	New price (IDR)	Used price (IDR)
RAM	300,000	5,000
Hard disk	500,000	20,000
Printer	600,000	25,000
Keyboard	75,000	5,000
Mouse	50,000	5,000
PSU	400,000	10,000
CD-ROM	300,000	10,000
Total	2,225,000	80,000

The reported cost comparison shows a reduction from IDR 2,225,000 to IDR 80,000, or approximately 96.4%. This economic dimension is pedagogically relevant because it enables repeated hands-on manipulation without requiring functional new components. It also aligns with circular-economy principles that prioritize reuse and value retention (Geissdoerfer et al., 2017; Ghisellini et al., 2016; Korhonen et al., 2018). However, the prices are local classroom estimates rather than a formal life-cycle cost analysis, and no environmental impact measurement was conducted.

Instructional Interpretation

The project converted peripheral identification from a largely abstract topic into a tangible design task. Students had to identify components, search for technical information, organize specifications, create a display product, present the result, discuss alternatives, and consult the teacher. This sequence combines cognitive, social, and practical dimensions of vocational learning. Such integration is consistent with research arguing that authentic projects are strongest when content knowledge, collaboration, reflection, and artifact quality are assessed together rather than treated as separate outcomes (Krajcik & Blumenfeld, 2006; Lucas et al., 2013; Scarbrough et al., 2004).

LIMITATIONS

Several limitations constrain interpretation. First, the study involved one class of 32 students and no comparison group, so the six-percentage-point increase in the mean creativity score cannot be attributed exclusively to PjBL "Diskon Babe." Second, creativity was measured with a brief teacher-observation checklist rather than a validated creativity instrument, and inter-rater reliability was not reported. Third, the source document contains inconsistent efficiency statements: the abstract reports 67% learning-time efficiency, whereas the conclusion reports 667%. Because no calculation procedure or time data are

provided, neither figure can be independently verified; the present article therefore does not treat learning-time efficiency as an established result. Fourth, the cost comparison is context-specific and may vary by market, component condition, and location.

CONCLUSION AND RECOMMENDATIONS

The two-cycle classroom action research indicates that PjBL "Diskon Babe," which combines discussion, consultation, and reused computer peripherals, was associated with an increase in mean observed creativity from 71% to 77%. Students showed the strongest Cycle 2 attainment in producing products (94%) and creating (86%), while expression of opinions improved substantially to 78%. The use of reused peripherals reduced the reported material cost by approximately 96.4%, illustrating how vocational projects can connect technical learning with resource efficiency. Future implementation should retain structured consultation, use validated creativity rubrics with multiple raters, document learning time consistently, and compare outcomes with other instructional approaches. Further studies could also measure environmental literacy and quantify the amount of electronic material diverted from disposal.

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