Analyzing Teachers' Digital Literacy and Students' Computational Thinking Using the Streamlit Dashboard: A Case Study of PPKS Foundation Schools

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Abstract: Teachers' digital literacy and students' computational thinking (CT) skills are increasingly important in 21st-century education. Secondary data from the Assessments of "Profil Kepala Sekolah dan Guru (PPKS)" and the Bebras Challenge were used to examine the link between the two. In addition, this study develops an interactive Streamlit-based dashboard for data visualization and evaluates user perceptions of the dashboard interface. A quantitative design was used by gathering secondary data from schools connected to the PPKS Foundation. Descriptive statistics was used to summarize data of the dataset and then, correlation analysis together with simple linear regression were performed to observe the association among variables. The findings indicate that the teachers' LD is correlated with the students' CT skills; however, a weak to moderate relationship between them appears. The implementation of interactive visualization tool like the Streamlit dashboard helped for easy interpretation of data to be made in education. This is also supported by feedback in user interviews that described the dashboard as accessible and providing assistance to comprehend complex data.

Keywords: Bebras Challenge; computational thinking; interactive dashboard; linear regression; digital literacy

I. INTRODUCTION

Digital devices play a role in new teaching and learning methods in schools, which make teachers use digital devices meaningfully [1]. Computational thinking (CT) has long been recognized as an important educational skill, as it can develop students' logical reasoning and problem-solving abilities. [2]. It is known from prior research that an increased use of technology in teaching is likely to be followed by enhanced student thinking and problem-solving performance [3]. Educational digital literacy is not merely technical skills but also includes critical understanding of information, responsible use, security and a positive learning environment [5]. Teachers who have high digital literacy skills are able to design learning environments where students are more likely to think critically and creatively [7]. The CT is a habit of mind and not exclusive to jobs related to technology [9]. The CT is often characterized in research by problem decomposition, pattern recognition, abstraction and trace back solution logic [10]. The development of critical thinking skills is linked to improvements in students' reasoning abilities, creativity, and problem-solving skills when they are consistently practiced.[11]. Students' computer programming skills (CT) are commonly evaluated through the Bebras Challenge, which includes logic-based tasks that require no prior programming experience [12]. Teachers' computer programming skills (LD) are typically evaluated through professional assessment systems like Assessments of "Profil Kepala Sekolah dan Guru (PPKS)" [8]. Differences in teachers' LD levels within PPKS-supported schools are associated with variations in students' CT performance, making this relationship important to examine quantitatively.

Interactive data visualization is frequently used to present patterns and trends more clearly compared to static charts [17]. In this

study, a Streamlit interactive dashboard was developed to support the analysis and presentation of data from PPKKS and the Bebras Challenge [4].

II. METHOD

To see how students CT connect with teachers' digital literacy, this study uses simple descriptive and correlation analysis. The student's data come from Bebras Challenge 2024, and the teacher's data taken from PPKS 2023 in the same schools.

Teachers' digital literacy data were collected using a Likert scale questionnaire from 1 to 5, covering four areas: digital skills, digital ethics, digital security, and digital culture. The scores from each area were averaged to get the overall teachers digital literacy score, and then grouped into three categories. CT data of the students were obtained from their scores in Bebras Challenge at elementary, junior high and senior high. As different test characteristics were used for each education level, the CT score ranges were normalized to a Min–Max scale before they were grouped. Both the levels were cross categorized into low, medium high using trisection method for more clear-cut description of ability distribution [13].

he connection between teachers' digital literacy and students' CT using Pearson or Spearman correlation at a 0.05 significance level [14]. This was mainly to see the strength and direction of the relationship, not to claim cause-and-effect. After that, individual linear regression was applied to check whether teachers' digital literacy could predict CT outcomes in students. The regression model's performance was evaluated using R^2, RMSE, MAE, and regression coefficients, which are commonly used in education data analysis [15]. Descriptive statistics were also provided to give a quick snapshot of the dataset.

For simplicity of interpretation the results were presented in an interactive Streamlit dashboard. Users are able to manipulate the data, patterns and trends more easily apparent than from static charts [16]. Streamlit [18] is a lightweight Python open-source framework to develop straightforward web-based analytics applications.

III. RESULTS AND DISCUSSION

A. Implementation of the Streamlit Interactive Dashboard

Rather than presenting users with lengthy tables packed with numbers, the dashboard utilizes visual representations to make the data more readable. Using this method, it is easier to see the patterns and relationships between different variables. This also makes the process of exploring the data feel simpler and less complicated, since users can interact with the visuals directly.

The main dashboard, shown at Figure 4.1, gives a general view of the analysis results. It shows correlation values, a simple prediction of students' CT, and some key numbers that describe the dataset. Before going into more detailed sections, this page helps users understand how teachers' LD skills are related to students' critical thinking abilities.

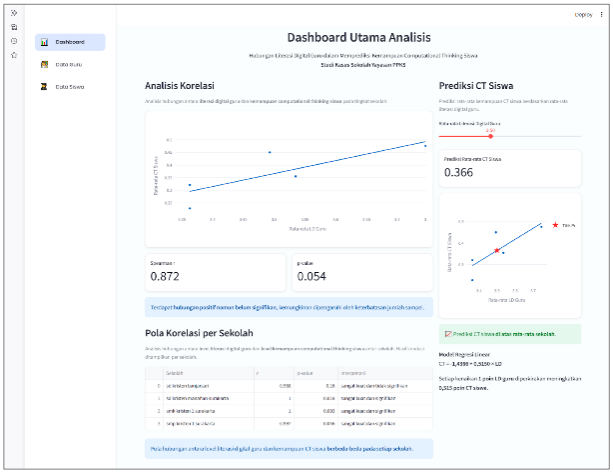

Figure 4.1 The Main Dashboard

The teacher dashboard uses teachers' digital literacy data and can be seen in Figure 4.2. It presents the number of teachers, average scores and distribution of literacy levels in charts and tables. Now when compare digital literacy levels between the schools, differences and trends are easier to perceive.

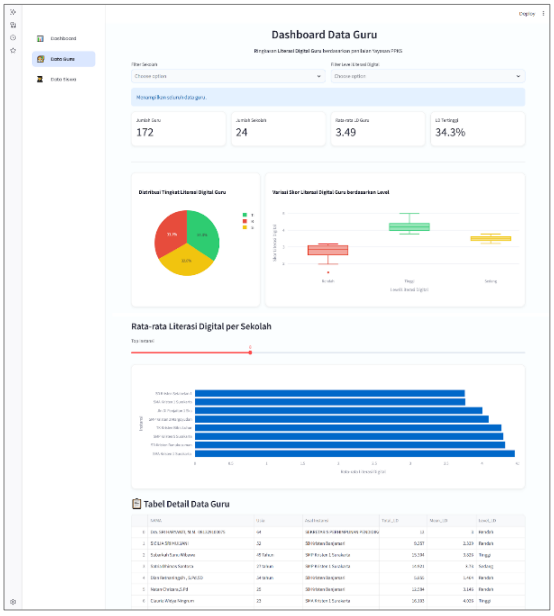

Figure 4.2 The Teacher Dashboard

The student dashboard displays information about students CT skills using normalized Bebras scores, see Figure 4.3. By revealing the general trends and differences in students' CT skills, this view gives an overview of the distribution of CT levels, group comparison statistics and school-level summary statistics.

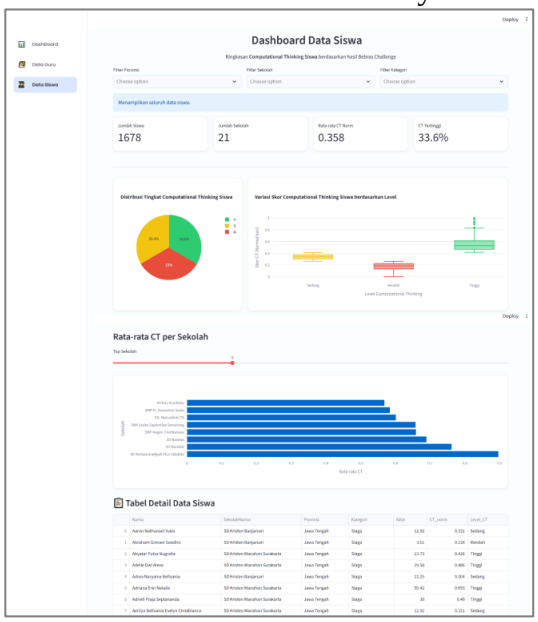

Figure 4.3 The Student Dashboard

1. Results of Interactive Dashboard Testing

An interactive dashboard test was performed to test usability, see the clarity of data visualization as well as overall user experience on the interface design. It is an interview-based method, consisting of four respondents who had used the dashboard in real life prior to the evaluation. All in all, all the participants were happy with the dashboard produced. While a few suggested a quick start guide, they thought it was user-friendly. A few charts required a short text to make them understandable and usable, but the other visualizations were easy to use. The interface was regarded as intuitive, clean and appealing. The dashboard also facilitated understanding of the data, which indicated that overall user experience was good. The navigation was easy, and many users found the visuals to help grasp teachers' digital literacy and students' CT skills more easily. A few users feel a small note in some charts and slight layout change would make it better. Judging from the feedback, it sounds like that dashboard is actually making education data more intelligible and fun to look over.

B. Analysis of Teachers' Digital Literacy and Students' CT Skills

This subsection analyzes the teacher's DL and student CT skills trend over all the data. The figures are based on an analysis of data from five schools, 172 teachers and 1,678 students. Before continuing with the further analysis, we pre-processed ability categorized and data classified into practice first by testing on correlations dan simple prediction was conducted.

Teachers' Digital Literacy

Teachers' LD was taken from the PPKS 2023 questionnaire. The dataset contains 45 columns: 5 identity-related fields and 40 digital literacy statements. Nevertheless, not all of them were included in the analysis. We selected 36 items with Likert scale, and 4 sentences were deleted.

Digital literacy in this research is defined in four perspectives as: digital skill, digital ethics, digital security and digital culture [6]. According to the analysis, most educators' LD levels were more widely distributed in the low, moderate, and high ranges. Trisection approach was used and about 33.14% of teachers had low digital literacy, 32.56% were

found to be medium and the remaining (34.30%) high in digital literacy. The distribution appears in Table 4.2.

Table 4.2 Distribution of Teachers' Digital Literacy Levels

	Level	Jumlah Guru	Persentase (%)
0	Rendah	57	33.14
1	Sedang	56	32.56
2	Tinggi	59	34.30

This finding indicates that even though some teachers are already digitally literate, some still need to develop it. These classifications are then utilized to analyze the students' CT competencies with regard to different levels of teachers' LD.

Students' Computational Thinking (CT) Skills

Data of CT level of students are extracted from the Bebras Challenge in different educational background, elementary (Siaga), junior high (Penggalang), senior SMA/SMK (Penegak). Since each level has different number of questions, score weight, and difficulty, the scores were first normalized using Min–Max method into range 0 to 1. In this step, the highest score in each group become 1 and the lowest become 0, while the other scores adjusted in between. This way makes the comparison between students and schools fairer and more consistent, even though they come from different education levels. The classification results indicate that students' CT skill levels are also relatively evenly distributed across the three categories.

Meanwhile, when grouped into CT levels, the student sample was almost evenly distributed, with 33.02% placed in the low level, 33.43% in the medium level, and 33.55% in the high level, as shown in Table 4.3. This balanced distribution suggests that students' CT skills are not concentrated at a single level and reflect variability in CT abilities across schools.

Table 4.3 Distribution of Students' CT Skill Levels

	Level	Jumlah Siswa	Persentase (%)
0	Rendah	554	33.02
1	Sedang	561	33.43
2	Tinggi	563	33.55

The normalization and classification procedures enable more consistent and proportional comparisons of students' CT skills. As a result, these groupings provide a reliable foundation for the next stage of analysis, which further examines students' CT skills across different levels of teachers' digital literacy.

Correlation Analysis

At the school level, correlation testing was applied by using the average scores of teachers' digital literacy and students' CT skills to represent each school's overall condition, as shown in Table 4.4.

Table 4.4 Average Teachers' Digital Literacy and Students' CT Scores

	sekolah_key	LD_Guru_Mean	CT_Siswa_Norm
0	sd kristen banjarsari	3.535	0.355
1	sd kristen manahan surakarta	3.493	0.450
2	sd kristen setabelan 1	3.746	0.476
3	smk kristen 1 surakarta	3.363	0.228
4	smp kristen 1 surakarta	3.363	0.321

The results of the Spearman correlation test across schools show a correlation coefficient of $r_s = 0.872$ ($p = 0.054$), indicating a very strong positive relationship, although it is not yet statistically significant. If teachers' digital literacy is better, students CT in the school usually become higher too. Even though the overall correlation between schools is not statistically strong, this internal pattern still shows a positive relation in most cases. When teachers have better digital skills, their students also tend to show higher CT ability. To see this more clearly, teachers and students were grouped into low, medium, and high levels and then compared. Some groups show clear positive relation, but in the medium group the pattern looks negative. Because the sample size is limited, these results should be seen only as general trend, not final conclusion.

Prediction Analysis

To see how teachers' digital literacy affects students CT at school level, simple linear regression was used. In this model, Y means the average students CT score and X means the average teachers digital literacy score.

The estimated equation from the analysis is written as:

$$Y = \beta_0 + \beta_1 X + \varepsilon$$

where Y represents the average CT score of students, X denotes the average teachers' digital literacy score, β_0 is value works as the starting point (intercept), β_1 shows how much students CT is expected to change when teachers' digital literacy increases, and ε means the error part in the model.

Based on the analysis, the estimated regression equation is:

$$Y = -1.4366 + 0.5150X + \varepsilon$$

Because the β1 value is positive (0.515), it means higher teachers' digital literacy is usually followed by higher students CT performance. The Adjusted R^2 value reaches 0.537, which tells that around 53.7% of the changes in students CT scores can be explained by teachers' digital literacy at school level. So, even though the model cannot explain everything, the direction of the relationship is clearly positive. A more complete summary of the prediction results is provided in Table 4.5.

Table 4.4 Predicted CT Values

No	Sekolah	LD_Mean	CT_Aktual	CT_Prediksi	Selisih
1	SD Kristen Banjarsari	3,535	0,355	0,384	-0,029
2	SD Kristen Manahan Surakarta	3,493	0,450	0,362	0,088
3	SD Kristen Setabelan 1	3,746	0,476	0,493	-0,017
4	SMK Kristen 1 Surakarta	3,363	0,228	0,295	-0,067
5	SMP Kristen 1 Surakarta	3,363	0,321	0,295	0,026

IV. CONCLUSION

Based on this study, the following conclusions are presented:

- Higher teacher LD tends to be associated with stronger student CT skills at the school level. However, the results not statistically significant, so these findings should be seen as exploratory.
- An interactive dashboard was created using Streamlit to display teachers' learning abilities and students' critical thinking skills in a visual form.. This makes it easier for users to explore the data.
- Feedback from users shows that the dashboard is easy to use, looks clear, and helps increase interest in analyzing education data.

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