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Modeling the Satisfaction of Data Literacy Online Training for High School Teachers Using PLS SEM

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Abstract

Background: The gap between before and after the pandemic is incredibly noticeable, especially in education. It mainly changes how schools operate their teaching and learning activities from offline to online. Indonesia must also implement online learning. The basic needs for data literacy in administration are strongly needed, such as inputting data for students' attendance, scores, and many more. Teachers need to improve their data literacy skills to help them evaluate and design new content structures for online teaching to meet students' required satisfaction. Therefore, the teachers' training program in data literacy always needs to be updated.

Objective: This study aims to determine the factors that influence teacher satisfaction in data literacy online training programs

Methods: This study employs partial least square structural equation modelling (PLS-SEM) to analyze the factors influencing teacher satisfaction in online data literacy training programs for high school teachers.

Results: The results show that the instructor's guidance, support, module content, and experience positively influence learner satisfaction in online data literacy training. The PLS-SEM can explain 62.53% of learner satisfaction

Conclusion: Online training providers can consider these variables their primary focus when providing high-quality online training, especially in data literacy. The instructor guidance and support include instructor expertise, the assistance provided, and many more, and the module content and experience include a suitable syllabus for the learner and the ease of use of the learning system.

Keywords : Learner Satisfaction, Online Teacher Training, PLS-SEM, Data Literacy Training.

Abstrak

Latar Belakang: Perbedaan antara masa sebelum dan sesudah pandemi sangatlah terlihat, terutama di bidang pendidikan. Perubahan terjadi pada cara sekolah menjalankan kegiatan belajar mengajar dari luring menjadi daring. Guru perlu meningkatkan keterampilan literasi data mereka untuk membantu mengevaluasi dan merancang struktur kurikulum baru dalam pengajaran daring guna memenuhi kebutuhan siswa.

Tujuan: Penelitian ini bertujuan untuk mengetahui faktor-faktor yang mempengaruhi kepuasan guru dalam program pelatihan daring literasi data.

Metode: Penelitian ini menggunakan *Partial Least Square - Structural Equality Modelling* (PLS-SEM) untuk menganalisis faktor yang mempengaruhi kepuasan guru dalam pelatihan online literasi data untuk guru SMA.

Hasil: Hasil penelitian menunjukkan bahwa bimbingan, dukungan, isi modul, dan pengalaman instruktur berpengaruh positif terhadap kepuasan peserta didik dalam pelatihan daring literasi data. PLS-SEM mampu menjelaskan 62,53% kepuasan peserta.

Kesimpulan: Provider pelatihan daring dapat mempertimbangkan bimbingan, dukungan, isi modul, dan pengalaman instruktur sebagai fokus utama mereka saat menyediakan pelatihan daring yang berkualitas, khususnya literasi data. Panduan dan dukungan instruktur mencakup keahlian instruktur, bantuan yang diberikan, dan masih banyak lagi. Konten dan pengalaman modul mencakup silabus yang sesuai untuk pelajar dan kemudahan penggunaan sistem pembelajaran.

Kata kunci: Kepuasan Peserta Didik, Pelatihan Guru Daring, PLS-SEM, Pelatihan Literasi Data.

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INTRODUCTION

One positive impact of the COVID-19 pandemic on the world is the rapid development and implementation of technologies in every aspect of our lives. It shapes a new culture and habit due to the mobility restriction to prevent the pandemic from spreading. Despite the limitations, we are now becoming more borderless regarding work flexibility. Adapting to this situation encourages individuals to work remotely or from home. Individuals can still finish their work wherever they are, even when not under direct supervision.

The gap between before and after the pandemic is incredibly noticeable, especially in education. It mainly changes how schools operate their teaching and learning activities from offline to online. In 2017, only 55% of people on average had used the internet in Southeast Asia, and more than 70% still had no internet access in Southeast Asian member countries such as Cambodia, Indonesia, Laos and Myanmar (IMF, 2018). Southeast Asia faces a massive challenge in implementing online learning, considering the conditions and limitations of some of their country members.

Indonesia also needs to implement online learning. Before the pandemic, technology implementation in the classroom from kindergarten until high school was rarely used. Both students and teachers could operate well even without using any computers. However, now, they are forced to use it as their primary driver for their learning activities. This adaptation is not easy, especially for teachers who are seniors.

Based on Indonesia's Ministry of Education, in the 2023/2024 academic year, more than 50% of Indonesia's teachers are older than 35 years old (Fig.1). This fact shows that most of the teachers in Indonesia will have difficulties or longer time to adapt in using the

technology for online learning. In addition, 46% of teachers in Indonesia barely have level 1 proficiency in digital literacy based on the UNESCO level, which means they can only browse, manage, store data, and many more in digital environments (Fathurrohman, 2020). The remaining 64% of teachers cannot even pass on level 1, which means very low digital literacy among teachers in Indonesia.

Based on UNESCO's Global Content Framework for SDG indicators 4.4.2 regarding the Percentage of youth/adults who have achieved at least a minimum level of proficiency in digital literacy skills, data literacy is included in the level 1 of digital literacy assessment. Data literacy is defined as a specific skill set and knowledge base that enables educators to transform data into actionable knowledge (Henderson & Corry, 2021). Data literacy is also recognized as a critical skill in the workplace, and there is a push to integrate it into the high school curriculum in Indonesia. This integration aims to prepare students for future learning and employment opportunities by enhancing their analytical and exploratory skills (Kaur et al., 2025).

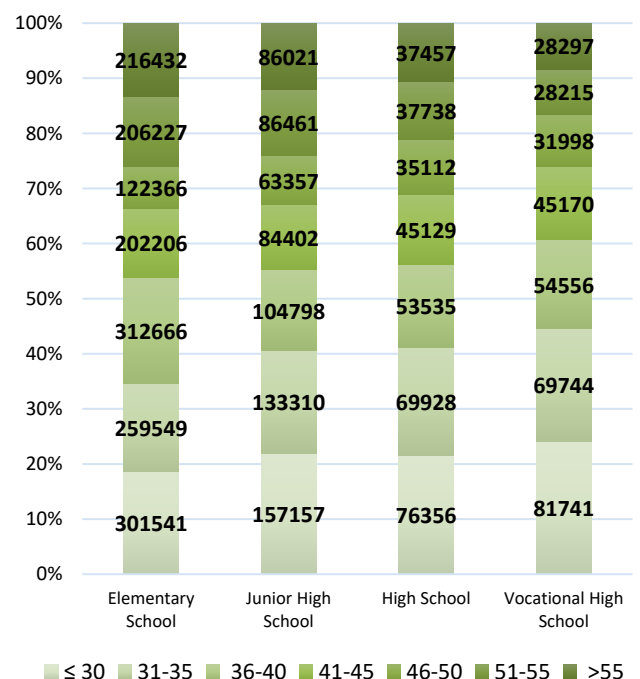


Figure 1. Age Distribution of Teachers in Indonesia's Schools in 2023/2024 academic year (Source: Ministry of Education in Indonesia, 2023).

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The teachers' capabilities in digital literacy must be enhanced to implement the online learning system, especially data literacy. The basic needs for data literacy in administration are strongly needed, such as inputting data for students' attendance, scores, etc. On the next level of data literacy, a teacher who acquires this skill can also increase their content and pedagogical knowledge based on the analysis of student performance data (Mandinach & Gummer, 2016). As data becomes increasingly integral to various fields, equipping teachers with data literacy skills is crucial for fostering a data-literate generation. Teachers must improve their data literacy skills to evaluate and design new online content structures to meet the students' required satisfaction.

Therefore, the teacher's data literacy training programme always needs to be updated. This study aims to model the factors that influence teacher satisfaction in data literacy online training programs to improve the quality of data literacy training for teachers. There has not been much literature about satisfaction in teacher training, especially in data literacy. This study contributes to the knowledge gap in studying learner satisfaction in online data literacy training for teachers.

The learner's satisfaction with the training program will be needed for evaluation and monitoring so that program providers can improve and define their strengths (Li et al., 2016). Many studies show that learner satisfaction in online classes depends on the course content and instructors (Baber, 2020; Bickle et al., 2019; Chen & Tat Yao, 2016; Harahap et al., 2021; Li et al., 2016; Pham et al., 2021). The learners perceive that a high-quality online course includes continual communication with the instructor (Bickle et al., 2019). This means that the support system for learning needs to be done continuously.

In addition, instructor's knowledge or guidance also positively influences student satisfaction in an online learning system (Baber, 2020). Based on that, this study will include instructor's guidance and support is included in the model.

Another study also showed that the learner's interaction with content, peers and instructors predicts student satisfaction in an online course using mixed methods such as correlation, factor and regression analysis. The course content is the most significant factor influencing the student's satisfaction (Pham et al., 2021). This aligns with another study from Malaysia, which used regression analysis to determine the factors influencing e-learner satisfaction. The result shows that among learner, instructor, course, technology, design, and environment dimensions, the design dimension is the only thing that significantly influences e-learner satisfaction. The learner wants to focus on learning the course content easily; they do not want a complicated system where they need to learn the system before they get to the content (Chen & Tat Yao, 2016). Therefore, the module contents and experience in the learning system are also included in the model.

Various analysis methods have been used to model learner satisfaction, such as regression, correlation, and factor analysis. However, those methods are best for analysing ratio data (Janah & Kartini, 2022). Those analyses are meant for the variable that can be measured directly and numerically. Therefore, the structural equation model is used in this study due to the variables used, instructor's guidance and support, module contents, and experience, which cannot be measured numerically and are considered latent variables. A latent variable is a conceptual variable that cannot be directly observed but can be proxied by indicators or directly observed variables in the questionnaires (Sarstedt et al., 2017).

Hence, this study uses the partial least squares structural equation model (PLS-SEM) to model learner satisfaction on data literacy

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training for high school teachers. The PLS-SEM is more beneficial than the usual SEM because it can extract the analysis by using less than 100 samples rather than having more than ten times the indicator number of samples in the usual SEM (Jaya & Sumertajaya, 2008). Based on Figure 1, there are more than 40% teacher who are younger than 35. Younger teachers are often perceived as digital natives, which suggests a natural familiarity with digital tools. This familiarity can lead to a more intuitive use of technology in educational settings, potentially fostering a greater interest in further developing digital skills (Jogezai & Baloch, 2023). Despite this, being a digital native does not inherently mean possessing advanced digital competencies. Many young teachers still require structured training to effectively integrate digital tools into their teaching practices (Görtl et al., 2024), so this study focuses on younger high school teachers. This study contributes to the gap in modelling data literacy training satisfaction for high school teachers in Indonesia.

METHOD

Research Design

This study employs a quantitative research design using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach to examine the relationships among latent variables in an online data literacy training. The model includes both outer (measurement) and inner (structural) models, and the estimation of parameters was conducted using SmartPLS. Statistical testing includes loading factors, path coefficients, and goodness-of-fit measures.

Population and Sample

The population of this study consists of high school teachers participating in an online data literacy training course conducted by the

Statistics Department, Universitas Islam Bandung. The training was held on April 3rd, 2021, and all participants in the training were included as the sample, using a census approach due to the limited and specific nature of the participants.

Sampling Techniques

This study used total sampling (census) where all individuals participating in the online training program were selected as the research sample. This technique ensures full representation of the population as the training participants are considered the entire population relevant to the research context.

Research Subjects

The data used in this research are primary data, collected directly from respondents through online questionnaires. The latent variables (constructs) investigated in the study include:

- 1) Instructor's Guidance and Support (IGS)
- 2) Module Content and Experience (MCE)
- 3) Learner Satisfaction (LS)

The hypothesized relationships between variables are summarized in Table 1.

Table 1. Relationships between variables.

No	Symbol	Relationships
1	H1	Instructor's guidance and support positively influence the learner satisfaction
2	H2	Module contents and experience support positively influence the learner satisfaction

The list of latent variables (construct) and all of the indicators used in this study can be seen in Table 2. Based on Table 1 and Table 2, the full model model of the PLS-SEM can be constructed which can be seen in Figure 2.

Table 2. List of The Constructs and Its Indicators.

No	Construct	Indicators	Questions
1	Instructor Guidance and Support	IGS1	Instructor can solve learner problems directly or indirectly (via assistant/facilitator)
		IGS2	Instructor expertise on the workshop material

No	Construct	Indicators	Questions
			help me learn more effectively
		IGS3	Instructor motivates the learner during the course
		IGS4	Instructor gives a clear procedure of how to do the assignment in the course
		IGS5	I feel helpful by the instructor assistance in this online facilitation in this course
		IGS6	this course is very useful in my career and the instructor can understand them so the learning process is efficient
			LS1 I am satisfied with the course content and the instructor in this course
			LS2 I am satisfied with the facilitators' help in this course
			LS3 Overall, I am satisfied with this course quality
			LS4 Overall, I am satisfied with the course experience
			LS5 Overall, I am satisfied with the content of the course
2	Learner Satisfaction	LS6	Overall, I am satisfied with the assignment in the course
		LS7	I am satisfied with the course delivery by the instructors
		LS8	I can recommend this course to another teacher
		LS9	The course meet my expectation
		LS10	I enjoy being in this course
		LS11	The course contributes skill in line with my career
3	Module Content and Experience	MCE1	Overall, I can follow the material given in the course
		MCE2	I can do all of the assignment and follow all activities in the

Figure 2. The Inner and Outer Model of PLS-SEM in Data Literacy Training Satisfaction

Data Analysis Techniques

The full model consist of The Outer and Inner Model, the formula of the inner model can be seen in Equation 1 and the outer model in equation 2 and 3.

$$\eta = B + \Gamma_1\xi_1 + \Gamma_2\xi_2 + \zeta \quad (1)$$

$$x_1 = \Lambda_{x1}\xi_1 + \delta_1 \quad (2)$$

$$x_2 = \Lambda_{x2}\xi_2 + \delta_2 \quad (3)$$

$$y = \Lambda_y\eta + \varepsilon \quad (4)$$

Where the η = LS and ξ_1 = IGS, ξ_2 =MCE; B is the intercept; Γ_i is a coefficient matrix for ξ_i where i = 1,2; ζ is the error term of the equation; x_1 is indicator of IGS, ; x_2 is indicator of MCE; y is indicator of LS; Λ_x and Λ_y are the loading matrix for x and y ; δ_i and ε is the error term of the Equation 2 and Equation 3, respectively. Those models are estimated and the coefficients which determine the relationship between variables are tested. The goodness-of-fit is also calculated using Equation 4 in order to see the model fitness.

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$$Q^2 = (1 - R_1^2)(1 - R_2^2) \dots (1 - R_p^2) \quad (5)$$

Where R_p^2 is the R-square for the p-th model.

RESULTS AND DISCUSSION

Descriptive Analysis

The sample consists of 55 high school teacher in Bandung who enrolled in the data literacy online training course on April 3rd, 2021. The respondents age distribution is provided in figure 3.a, the respondents are quite well proportioned in every category of age such as 20s, 30s, 40s and 50s. In addition, most of the respondents are teaching mathematics in their school (Figure 3.b).

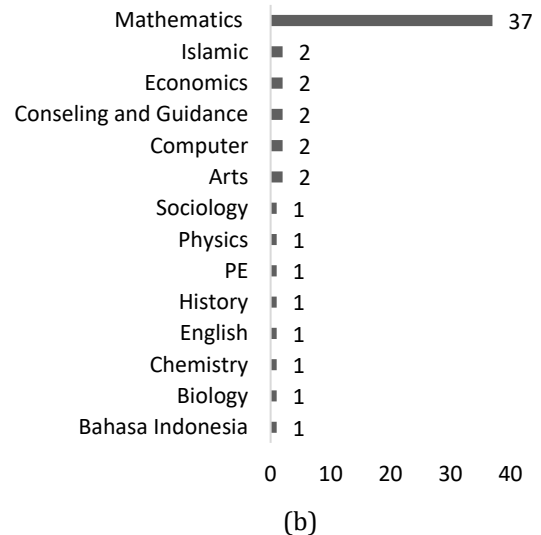
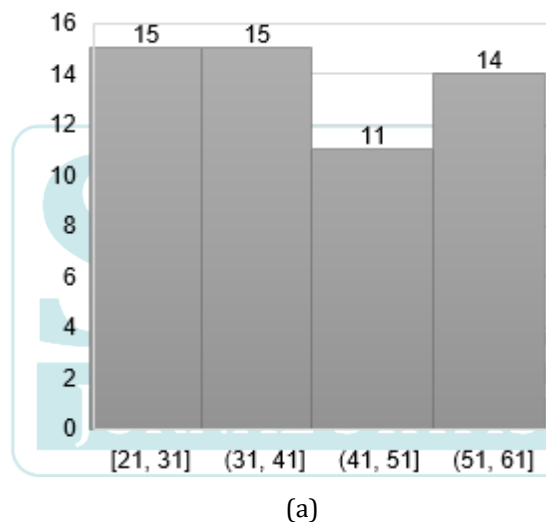


Figure 3. Respondents (a) Age and (b) Teaching Subject Distribution

The result of the indicators can be seen in Table 3. The best 5 performing indicators are in the instructor guidance and support variable for IGS1, IGS2, IGS4, IGS5 and the learner satisfaction variable especially in course quality (LS3) are 100%. This means all learner agree with indicator statements. The worst 2 performing indicators are in the module contents and experience variable especially about the assignment (MCE2) and the online material (MCE4). Despite being the worst indicator, they still have a great score which shows that more than 84% of the respondents feel that they can follow along the assignment, and they feel easy to access the online material.

Table 3. The best and worst performing indicators.

No	Symbol	Indicators statement	Disagree	Neutral	Agree
Best 5 indicators					
1	IGS1	Instructor can solve learner problems directly or indirectly (via assistant/facilitator)	0%	0%	100%
2	IGS3	Instructor motivates the learner during the course	0%	0%	100%
3	IGS4	Instructor gives a clear procedure of how to do the assignment in the course	0%	0%	100%
4	IGS5	I feel helpful by the instructor assistance in this online facilitation in this course	0%	0%	100%
5	LS3	Overall, I am satisfied with this course quality	0%	0%	100%
Worst 2 indicators					
1	MCE2	I can do all of the assignment and follow all activities in the course	2%	9%	89%
2	MCE4	It is easy to access the online material	0%	16%	84%

Modeling the Satisfaction of Data Literacy Online Training for High ... Partial Least Square – Structural Equation Modeling (PLS-SEM)

The analysis of PLS-SEM starts from estimating the loadings for each indicator. The loadings score for each indicator should be more than 0.7 in order to be valid. The loadings score can be seen in Table 4. The loading of IGS1, IGS4, IGS5, LS1,LS8 indicators are less than 0.7 which means these indicators are not valid and can be excluded from the outer model.

Table 4. The Loadings of Indicators.

No	Indicators	Loadings	No	Indicators	Loadings
1	IGS1	0.629*	13	LS1	0.657*
2	IGS2	0.823	14	LS2	0.753
3	IGS3	0.736	15	LS3	0.72
4	IGS4	0.625*	16	LS4	0.788
5	IGS5	0.641*	17	LS5	0.822
6	IGS6	0.704	18	LS6	0.828
7	MCE1	0.732	19	LS7	0.825
8	MCE2	0.81	20	LS8	0.585*
9	MCE3	0.846	21	LS9	0.849
10	MCE4	0.767	22	LS10	0.809
11	MCE5	0.744	23	LS11	0.731
12	MCE6	0.731			

Note: *Loading value is less than 0.7

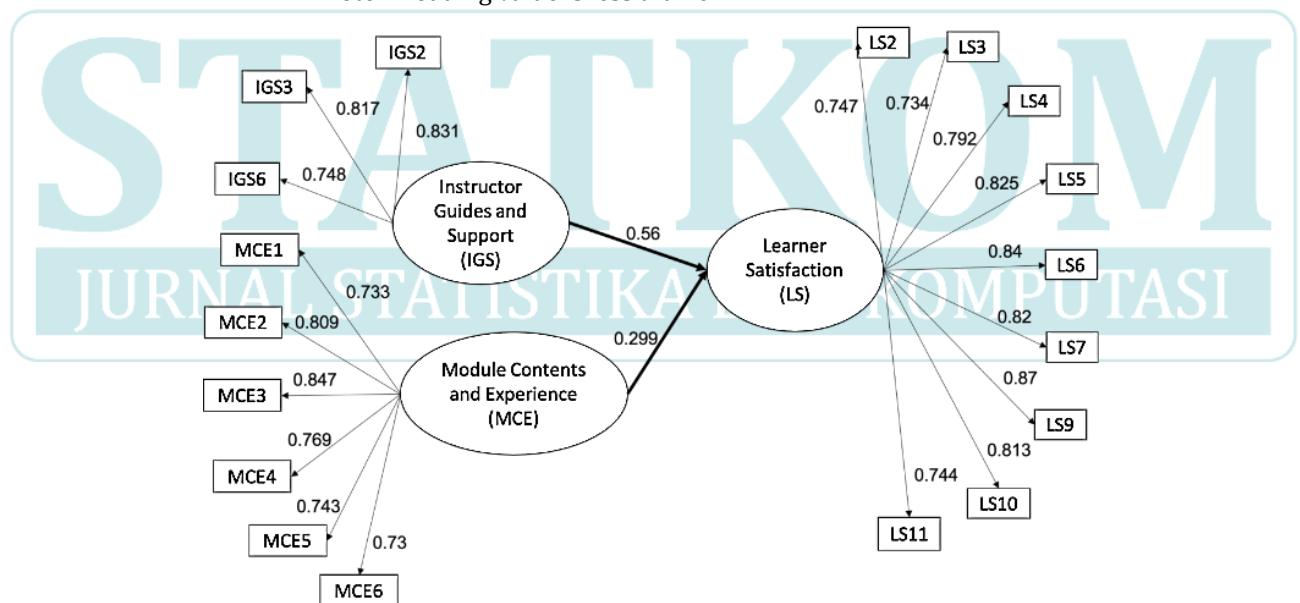


Figure 4. The Estimation of the full PLS-SEM of Learner Satisfaction in Data Literacy Online Training

Next, the unidimensionality of the block indicators measure the construct by looking at the cronbach alpha and Dillon-Goldstein's (DG) rho values. Both values need to be more than 0.7. In Table 4, we see that every construct has more than 0.7 in both cronbach alpha and DG rho. This means that the indicators proxied the construct well.

Table 4. The Unidimensionality Indicators.

No	Construct	Cronbach Alpha	DG rho
1	Instructor Guidance and Support	0.786	0.849
2	Module Content and Experience	0.864	0.899
3	Learner Satisfaction	0.928	0.939

Note: *Loading value is less than 0.7

After all the indicators and latent variable are valid, the estimation and coefficient testing for the model. The outer model

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estimation can be seen in Equation 5.

$$LS = 0.000 + 0.56(IGS) + 0.299(MCE) + \zeta \quad (5)$$

The estimation of the full model can be seen in figure 4 and the coefficient testing can be seen in Table 5. Both variables, Instructor guidance and module contents experience are positively influenced the learner satisfaction. This means the initial hypothesis (Table 1) are accepted.

After that, we can see that the goodness-of-fit of the model is 62.53%, which is quite good fitness. This means that 62.53% variation of learner satisfaction can be explained by variation of the variables in the model, and the remaining 37.47% variation explained by variables outside the model.

Table 5. The Estimation and testing of coefficient in the outer model.

Variable	Estimate	Std.Error	t-value	P-value
Intercept	0.000	0.0849	-0.000	1
IGS	0.56	0.1133	4.94	0.00000
MCE	0.299	0.1133	2.64	0.01*
Goodness-of-fit				0.6253

Note: *p-value < 0.05.

Discussion

The results show that the indicators' overall score is relatively high, as more than 84% of the respondents agree with the indicators. This means most respondents feel satisfied with the instructor's guidance and support, learner satisfaction, and module content and experience. This result is obvious since more than 50% of the sample are mathematics teachers, so they are pretty familiar with data literacy skills. Despite being the worst indicators (MCE 2 and MCE 4), more than 84% of the sample agree that accessing the online material and doing the assignment is easy. This is probably because we do not use specific LMSs, only Zoom online meeting platform, Google Drive, and YouTube to share the material. This is probably why it is still high; the respondents commonly used

that application, so they had no difficulties finding the materials.

Based on the PLS-SEM, the module content and experience positively influence learner satisfaction. This result is in line with results from Chen & Tat Yao (2016), Li et al. (2016), Pham et al. (2021). The respondents feel very comfortable with the course design, the easily accessed system, or the platform most learners commonly use. Therefore, in line with the descriptive analysis, the satisfaction rate of this training is high. The design of the course content and the learner's experience in the online training are important to consider in making good quality online training.

However, the instructor's guidance and support contribute more to the learner satisfaction than the module content and experience. This is in line with the results from Baber (2020), Bickle et al. (2019), and Li et al. (2016). The communication between the learner and instructor needs to be good to achieve satisfying online training. The learner expects the same outcome from training online and offline. They wanted to be guided and assisted through the learning activities so they could fully understand the training content.

CONCLUSION

Conclusion

This study aims to determine the factors that influence teacher satisfaction in data literacy online training programs to improve the quality of data literacy training for teachers. The results show that instructor guidance and support (IGS) and module content and experience (MCE) positively influence learner satisfaction in online data literacy training. The model we estimated can be seen in Equation 4, explaining the 62.53% variation in learner satisfaction. Online training providers can consider these variables their primary focus when providing high-quality online training, especially in data literacy. The instructor guidance and support include instructor expertise, the assistance provided, and many more, and the module

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content and experience include a suitable syllabus for the learner and the ease of use of the learning system.

Suggestions

The limitation of this study is that the samples mostly come from mathematics backgrounds, and it is limited only to high school teachers. For future studies, we recommend doing the research with more distributed teachers from various backgrounds (not only mathematics) and school levels, such as elementary school teachers until vocational school, in order to have a representative sample for all teachers.

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