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Research Article

Developing a Learning Style-Oriented Small Private Online Course (SPOC) with Norm- Referenced Testing (NRT) Integration

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Abstract:

This research explores the development of Small Private Online Courses (SPOC) to address the limitations of MOOCs, particularly in personalization and learning effectiveness. A survey of 140 students revealed that 92.9% preferred materials suited to their learning styles (visual, auditory, kinesthetic), 63.8% sought integration with automotive-related mathematics, and 73% desired flexible yet private online learning. Using the Borg & Gall R&D model for needs analysis and the Dick & Carey approach for development, this study designed a learning style- based SPOC. Expert validation confirmed its feasibility, and statistical analysis (Pearson correlation, Cronbach's Alpha) ensured its reliability. The effectiveness evaluation showed moderate learning gains (N-Gain: 0.64-0.66) and significant improvements based on a Paired Sample T-test. Observations indicated enhanced engagement, attitudes, and interest. Implementing SPOC with learning style-based grouping fosters collaborative, immersive learning, improving effectiveness in vocational education.

1. Introduction

1.1 Research Trend SPOC (Base on Scopus Database)

The adoption of SPOC (Small Private Online Course) in education, particularly for vocational students, is on the rise due to its personalised and focused approach compared to MOOCs. SPOCs provide tailored learning resources based on students' age and cognitive styles, such as texts, PPTs, and videos, enabling better learning organisation [20]. They also help overcome geographical barriers, ensuring timely and accurate content delivery to support diverse learning needs [33]. In vocational education, SPOCs enhance student motivation through blended learning that combines online and offline methods [8]. The integration of IT optimises teaching formats and facilitates experience sharing among educators [34]. Additionally, school policies, such as syllabus adjustments and course selection systems, support SPOC development [61]. While SPOC instructors are certified, further training is needed to enhance their ability to engage students and provide support in and out of class [23]. Overall, SPOCs offer a more targeted and effective solution than MOOCs in addressing specific and personalised educational needs [65].

SPOCs were developed to address MOOCs' limitations, particularly the "two-tier paradox" of high enrolment but low completion rates, as well as sustainability challenges due to costs and limited teacher involvement [61]. By restricting access and reducing class sizes, SPOCs strengthen teacher roles, encourage self-directed learning, and enhance interaction [56]. Their simpler operational mechanism reduces learner management complexity [56]. Additionally, SPOCs improve student supervision, boost completion rates, and promote effective learning [54]. The integration of online and offline learning enriches customisation and enables timely interventions [16]. Thus, SPOCs serve as a more effective alternative to MOOCs in meeting students' personalised learning needs [60].

1.2 Gap and Problem SPOC

A major issue in SPOC implementation is the insufficient emphasis on its "private" aspect, which should be a core advantage. Although designed for smaller, focused groups, SPOC often lacks true personalization, failing to fully address individual student needs [34]. This can lead to disengagement, especially when materials do not align with learning preferences [41]. While SPOC offers flexibility in workload distribution, challenges remain in customizing content to meet students' specific needs [48].

1.3 Empirical Study

This research focuses on the results of a case study conducted on class X students majoring in (TKR) at SMK Negeri 3 Light Vehicle Engineering Kuningan, West Java. The results of preliminary research show that most students have difficulty in understanding mathematics, English, and Physics. Of the 140 students who filled out the questionnaire, 108 students chose mathematics as the material that was difficult to understand. Based on the data obtained, 92.9% of students need materials that suit their learning style (Figure 1. a). additionIn, 63.8% of students want general subject matter that is combined with automotive science (Figure 1.b). Furthermore, 73% of students felt the need for flexible but private online learning provided in the LMS media/platform so that students can access the material anytime and anywhere (Figure 1.c).

This data underlines the importance of tailoring teaching materials oriented to students' learning style preferences, a solution that can be proposed is the development of SPOC (*Small Private Online Course*) Oriented to Learning Style Preferences in the formation of collaborative learning Learning groups, such as visual, kinesthetic, and auditory researchers also added the NRT (*Norm-Referenced Testing*) student Outcome Analysis variable to the SPOC system by adding N-Gain value information automatically after students complete the pretest and posstest. Thus, educators can identify students' dominant learning styles and customise their assignments to meet students' individual needs [32]. Then the research questions are as follows:

1. How to develop an orientated SPOC Learning Style Preferences in Student Assignments?
2. How to design/prototype SPOC orientated Learning Style Preferences in Student Assignments?
3. How to test the feasibility & effectiveness of an orientated SPOC Learning Style Preferences in Student Assignments?

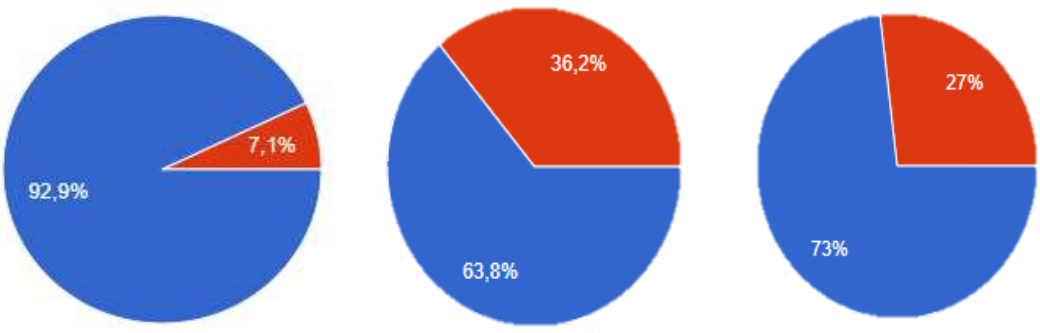
1.4 Research Novelty

To bridge SPOC's personalization gap, integrating **VARK (Visual, Auditory, Reading, Kinesthetic)** learning styles into its design can enhance engagement and effectiveness [22]. Studies show this approach benefits fields like programming and nursing education [28, 52] . VARK also helps students adapt learning strategies, increasing autonomy and satisfaction [23, [40].

The **Barsch Inventory**, developed by Honolulu Community College, provides accurate, online-accessible learning style assessments, making it relevant for SPOC [25]. Additionally, as direct instructor interaction in SPOC is limited, VARK allows students to tailor learning methods to their needs, ensuring flexibility and effectiveness [19, 42].

2. Literature Review

2.1 Difference between Small Private Online Course (SPOC) and Massive Open Online Course (MOOC)



(a) (b) (c)

Figure 1. *Needs Students' for (a) StylesLearning , (b) Teaching Materials Mathematics in the Automotive Field, (c) Private Online Learning*

A Small Private Online Course (SPOC) is designed for smaller groups, unlike a Massive Open Online Course (MOOC), which accommodates thousands of participants. SPOCs address MOOC limitations, such as the lack of personalization and direct instructor support. By blending online and face-to-face elements, SPOCs allow for deeper, more tailored interactions
[8, 54]. They emerged to create more efficient, focused learning environments through technology, enhancing flexibility and accessibility [27]. Table 1 outlines the key differences between SPOC and MOOC.

2.2 Learning style Visual, Kinesthetic, Auditory (VAK)

Online learning has transformed student interaction with learning materials, and VAK learning styles significantly influence its effectiveness. Visual learners benefit from images, diagrams, and animations, as they rely on visual memory to recall information [24, 29]. However, excessive visual elements can be distracting, requiring careful design [29] . Auditory learners absorb information through sound and verbal repetition. They benefit from audio lectures but may struggle with text-heavy discussions [12]. Recording lessons for later review is an effective strategy [29]. Kinesthetic learners prefer hands-on learning and physical engagement. Online learning poses challenges due to limited physical activity, but interactive tasks like drag-and-drop exercises or real-world applications can help [45]. Role-playing and drama can further enhance their experience [24]. Learning styles can be assessed using the Barsch Learning Styles Inventory, a standardized tool developed by Jeffrey Barsch. It includes 24 statements rated on a three-point Likert scale (5 = often, 3 = sometimes, 1 = rarely). Specific statements categorize auditory, visual, and kinesthetic learners accordingly [14].

2.3 Relationship between learning styles and outcomeslearning

Learning styles significantly influence student outcomes, including CGPA and self- directed learning (SDL) hours in integrated dental curricula [15]. Awareness and effective utilization of learning styles can enhance academic performance [38]. Thus, understanding individual learning styles serves as a valuable strategy for improving academic achievement.

Table 1. *Differences in Scope of SPOC and MOOCs*

Difference between SPOC and MOOC			
Scope	**MOOC**	**SPOC**	**References**
Participant Scale	MOOCs serve tens of thousands of students simultaneously	while SPOC caters for a smaller group	[60]
Interaction	MOOCs have limitations in the interaction between instructors and students due to their large scale	while SPOC allows for more in-depth and personalised interactions	[5] [60]
Individual Needs	MOOCs are less able to fulfil students' individual needs due to variations in learning skill levels	whereas SPOC is better able to adapt to individual needs	[60]
Completion Rate	MOOCs have a low completion rate	while SPOC has a higher completion rate	[35]
Use of Resources	MOOCs provide a variety of publicly accessible course resources	whereas SPOC uses platform- based resources in more scalable classes	[5]
Flexibility	MOOCs allow access to course materials anytime and anywhere	whereas SPOC is more structured with more focussed interactions	[61]
Evaluation	MOOCs face challenges in online evaluation	whereas SPOC can resolve evaluation integrity issues through exams in physical classes	[35]
Learning Approach	MOOCs are more open and massive	whereas SPOC is more private and focussed	[66]
Use of Technology	MOOCs often utilise technology to deliver content widely	whereas SPOC uses adaptive technology to tailor the learning experience to individual needs.	[35]
Student Engagement	MOOCs often lack in terms of student engagement due to their large scale	whereas SPOC increases engagement through more personalised interactions	[66]

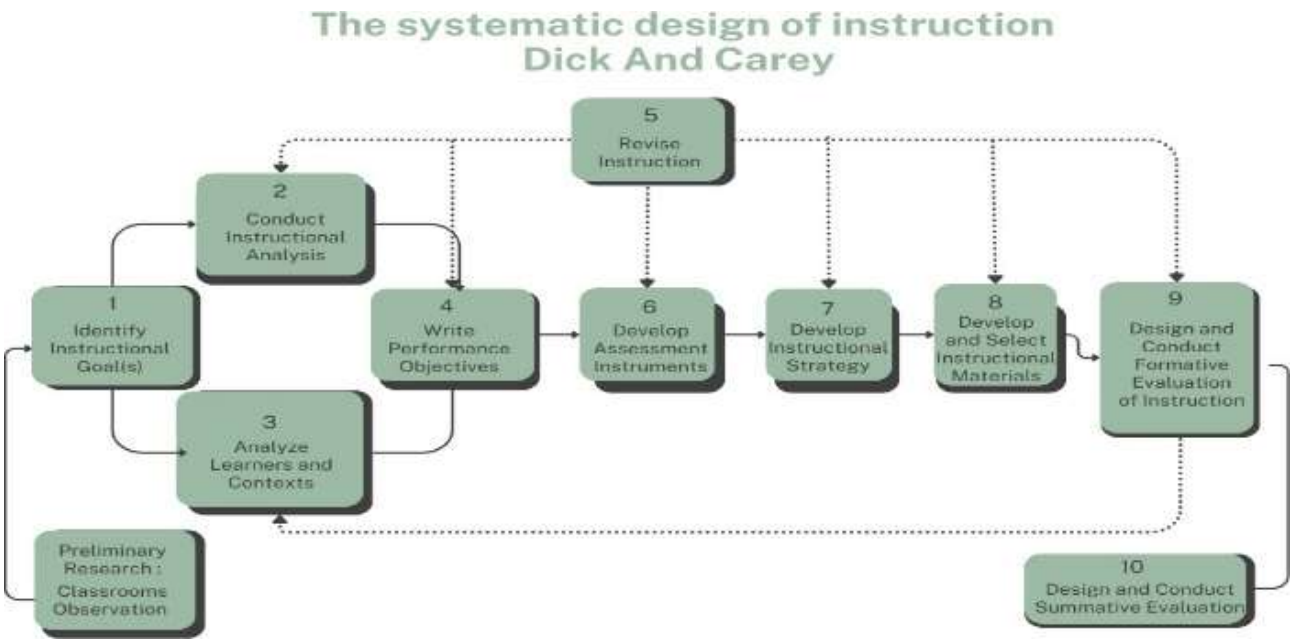


Figure 2. *The Systematic Design Of Instruction Dick And Carey*

2.4 Norm-Referenced Testing (NRT)

Norm-Referenced Testing (NRT) assesses individuals by comparing their scores to a normative group. Used since the 1920s in psychometric testing, it measures mental abilities, including intelligence [49]. NRT helps decision-makers compare, differentiate, and select candidates, commonly applied in admissions and job placements [43]. Educators use NRT to identify specific learning disabilities (SLD) by analyzing performance gaps between IQ and achievement tests [17]. Additionally, it evaluates large groups at specific intervals, as seen in the American school system for policy and school assessments [43]. Thus, NRT provides standardized data for tracking student achievement trends and informing educational decisions.

3. Method

This study uses *Research And Development* Methodology, the researcher used the Borg & Gall preliminary research approach Phase 1 *Research and Information Collecting: Classrooms Observation* to determine student needs [67], then used Dick and Carey's which development offers a systematic framework in instructional design that enables the development of effective SPOCs (Fig. 2), with attention to needs analysis, designing learning objectives, developing materials, and evaluating learning. In the context of developing SPOC based on students' learning style preferences, this approach can be enriched by the use of 3 learning style categorisations (auditory, kinesthetic, visual) to understand and improve the learning process. [68].

3.1 Participant

Material, learning design, and media learning experts assess the feasibility of content validation, Samples in the trial process to see the effectiveness of SPOC (Figure 3) and 3 construct validation include 3 people, groups of phased trials, namely one-to-one as many as Small group 34 people, and field tral 36 people (Table 2.). In addition to seeing the increase in student , stage learning effectiveness resultsthis is applied so that researchers can revise the product from the input of each trial group which is part of step 5 of Dick and Carey.

Table 2. *Stages of SPOC Product Trial in Formative Evaluation*

Group	Pretest	Treatment	Posttest
One to one	Y1	XO	Y2
Small Group	Y1	XS	Y2
Field Test	Y1	XF	Y2

Description:
Y(1) = Pretest.
Y(2) = Posttest.
XO = Use of One to one trial group SPOC . XS = Use of SPOC in the small group .trial XF = Use of SPOC in the Field Test .group

3.2 Procedure for Collecting Data (Formative Evaluation)

Figure 3. *Five Stages of Formative (Evaluation SPOC and Trial) Feasibility*

3.3 Data Analysis

This study analysed data using an interval scale with five response options to assess the suitability of teaching , materialslearning design, and SPOC media to students' learning styles. Data from experts were calculated based on the total average , scorewhile student data were validated using Pearsons 'Bivariate Correlation with cut-off 0.334 (35 values of samples) and
0.329 (36 samples). test Cronbach's Alpha reliability ensured the consistency of the instrument (≥0.6). Questionnaires were completed online, while interviews were analysed descriptively.
Paired Sample T-Test and N-Gain tests were used to assess the effectiveness of SPOC based on the comparison of T-Count and T-Table values and the improvement of student learning outcomes.

$$N - Gain = \frac{(Skor\ Posttest - Skor\ Pretest)}{(Skor\ Maximum - skor\ pretest)}$$

4. Results

SPOC Development Results Using Dick And Carey

4.1 Decision General Learning Objectives

The .general learning objectives for phase E of the Mathematics subject at SMK based on the Decree of the Head of the Education Standards, Curriculum and Assessment Agency Number 032/H/KR/2024 are to develop students' understanding of the concepts of positive, negative, and fractional numbers; analyse and use the properties of power numbers in mathematical operations; and apply patterns of arithmetic and geometric rows and series to solve contextual problems, so that students are able to think logically, analytically, and creatively in various real situations.

4.2 Learning Analysis Results

Based on the learning analysis in the preliminary research, several main problems were found. Grade X students majoring in difficulties Light Vehicle Engineering (TKR) have learning because the teaching materials have not been adapted to their learning style preferences. Observations in classes X TKRO 1, 2, and 3 showed that 73 students had not mastered tens multiplication, while 87 students had difficulty in division with comma entities. additionIn , there has been no development of Small Private Online Course (SPOC) as a medium for distributing mathematics teaching materials that suit the needs of vocational . In the studentscontext of the automotive major, students need practical and interactive materials to understand technical concepts better, in line with research showing that the utilisation of learning styles can improve academic performance [55]. The need for interactive e-modules also emphasises the importance of developing digital media that suit students' learning preferences.

4.3 Results of Identification of Student Characteristics Based on Learning Style

The results of the *non-test* analysis of the *barch inventory* on students in class X TKR 2 showed that they have diverse learning style preferences, with 12 students tending to be visual, 11 kinesthetic, 6 auditory, and 7 with no specific preference. To optimise learning, the researcher formed six collaborative learning learning groups that incorporated all three styles in each group. This approach was designed to allow students to complement each other, creating a more dynamic, interactive and personalised learning environment.

4.4 Decision ObjectivesSpecific Instructional

Specific instructional objectives are designed to optimise student achievement by considering the general instructional objectives, learning analysis, and students' learning style preferences. objectives performance These include students' ability to answer HOTS questions related to vehicle fuel efficiency through multiplication and division operations, analyse vehicle engine data using the properties of power numbers, and solve contextual problems with the concept of arithmetic rows and series to calculate vehicle periodic maintenance schedules.
This aims to develop critical, analytical, and contextual thinking skills according to the needs of the world of work.

Table 3. *Research Blueprint Matrix with Dick 's Domain of Stepsand Carey*

Domain	Indicators	Appraiser	Reference
Identify & Define ObjectivesLearning	Clear lesson planning and design	Learning Design Expert	[53]
Conduct a Learning Analysis	Participant needs analysis, blended learning , implementationand resource and data management are conducted comprehensively and effectively to support learning.	Learning Design Expert	[73], [74], [18], [75], [4], [30]
Identifying Students' Learning Style Characteristics	Students' learning styles can be categorised using the SPOC platform.	Learning Media Expert	[69]
Defining Specific Learning Objectives	Learning outcomes have been in accordance with the rules set by the Ministry of Education	Learning Design Expert	Decree of the Head of the Education Education, Standards, Curriculum and Assessment Agency of the Ministry of Culture, Research and Technology No. 032/H/KR/2024. Phase E (SMK)
Developing a Learning Strategy	The collaborative and systematic learning structure, with the integration of the Station Rotation approach, supports effective interaction, self-directed learningsynchronous collaboration, and continuous evaluation through flexible asynchronous and synchronous sessions.	Learning Design Expert Learning Media Expert Material Expert Learning	[48], [73], [62], [75], [54], [3], [11] [36] [18] [30] [74]

4.5 Product Revision Process

Expert Review recommends a *Flip-Interactive Book* in the SPOC system to combine visual, audio and kinesthetic content on one teaching material to support collaborative group learning of learning styles, students.

4.6 Instrument Development Results

The that instrument refers to the matrix blue print (Table 3.) is then tested for context validation, construct validation, and testreliability . Based on the results of the content validity test through expert judgement, all variables at the Small Group and Field Test stages were rated "Very Suitable" (Tables 4&5) indicating the suitability of the instrument with the measurement objectives. From the aspect of construct validity using Pearson Correlation, all r-calculated values in the Small Group and Field Test are greater than r-table (0.339 for Small Group and 0.329 for Field Test), which means all instrument items are statistically valid. However, the correlation values in the Field Test tended to be lower compared to the Small Group, for example in Learning Design (0.568 in Field Test vs. 0.654 in Small Group), Learning Materials (0.639 vs. 0.691), and Instructional Media (0.678 vs. 0.744). This indicates that the reliability and interitem consistency have slightly decreased after wider testing, although they remain in the valid . categoryMeanwhile, Cronbach's Alpha remained above 0.8 for all variables, indicating that the instruments had excellent reliability.

Table 4. *ResultsSmall Group Content Validation and Construct Validation*

Small Group	N.Item	Expert Judgement	Pearson Correlation	Cronbach's Alpha
Learning Design	22	Very suitable	.654	.936
Learning Materials	13	Very suitable	.691	.908
Instructional Media	10	Very suitable	.744	.910

Table 5. *Results of Content Validation and Field Test Construct Validation*

Field Test	N.Item	Expert Judgement	Pearson Correlation	Cronbach's Alpha
Learning Design	22	Very suitable	.568	.899
Learning Materials	13	Very suitable	.639	.877
Instructional Media	10	Very suitable	.678	.868

4.7 Learning Strategy Development Results

Learning strategies are designed by considering the sustainability of the the achievement of student learning process and competency-based learning objectives as stipulated in the *Decree of the Head of the Education the Ministry of Education, Standards, Curriculum and , Research and Assessment Agency of CultureTechnology Number 032/H/KR/2024*. One approach that can be applied in the *Small Private Online Course* (SPOC) system is the *station rotation* learning strategy (Figure 4.), which is oriented towards learning style preferences and *Norm- Referenced Test* (NRT) to create a more adaptive and personalised . learning experienceThis approach allows to students move between different learning stations, either synchronously or asynchronously, to improve learning outcomes [3]. In modelthis , students rotate through different stations, online learning, including group work, and individual assignments, which allows for a more structured approach to student needs [7]. This approach aligns with the characteristics of SPOCs that provide learning content on a small scale, allowing for more intensive interaction between teachers and students and adapting learning learning methods to dominant styles [9]. . In addition, the integration of *station rotation* in SPOCs can enhance understanding through technology-based and *hands-on* activities, such as digital that educational tools support conceptual learning [10]. With the flexibility offered, this approach supports educational institutions in creating dynamic learning environments, increasing student engagement, as well as enabling NRT-based assessments to measure student performance more accurately [21].

Figure 4. *Application of Station Rotation in SPOC Development*

4.8 Materials and Media Development Results

Researchers have developed teaching and media materials oriented towards students' learning style preferences. Pelita Pendidikan' SPOC prototype shas features including automatic grouping based on students' learning style preferences, and the creation of a Flip- Interactive Book that accommodates students' sensory (Visual, Auditory, Kinesthetic) (Figure 6). The . name NRT evaluation feature (Figure 5) in this context includes several important elementsThe . name student's is used to identify the participantThe material indicates the topic tested in the pretest and posttest. Pretest scores reflect initial understanding before accessing the SPOC, while posttest scores measure improvement after learning. Categorisation determines achievement levels based on fluctuations in scores across the sample, comparingstudents within a group. Finally, N-Gain measures the effectiveness of learning by looking at the difference between pretest and posttest, which is normalised to avoid initial score bias.

Figure 5. *Implementation of Norm Referenced Testing on SPOC*

Figure 6. *Feature Student Learning Style Identification on SPOC*

The use of station rotation strategy in blended learning on small private online courses oriented towards students' learning style preferences has several advantages (Figure 7). First, model this allows students to move between various learning stations, including at least one station that uses an online learning approach, thus providing flexibility and variety in learning methods [3]. Secondly, strategy this allows teachers to provide direct instruction at of the onestations, thus being able to focus more on the individual needs of students [3]. Third, the division of the class into stations allows students to work on different tasks at each station, which can improve their overall learning outcomes. Fourthly, model this can promote co-operative learning and student engagement through different

instructional activities [11]. Lastly, strategy this is easy to implement and effective in improving student learning outcomes.

The Small Private Online Course (SPOC) has integrated learning with engaging visual elements to meet the needs of students with visual . In learning preferencesthis context, visual learning involves the use of engaging images, videos and animations to help students understand the material better (Figure 9). For example, in a mineralogy course, material is delivered through various sensory modes, including visual, using PowerPoint that utilises digital resources such as virtual and microscopes 3D animations [1]. In addition, e-learning platforms such as APPEAL also provide lessons in visual, aural, text and kinesthetic presentation modes, designed to suit students' learning styles [47]. In online , the learninguse of videos and virtual tours also can enhance student understanding by providing an immersive visual experience [63]. method This is in line with the application of the VARK that learning style has been used in various educational fields to improve the acceptance of educational technology by learners [28]. As such, visual learning in SPOC is designed to provide an engaging engagement and interactive display of images, so as to increase student and learning motivation [47].

The Small Private Online Course (SPOC) has adopted kinesthetic learning to meet the needs of students who have kinesthetic learning preferences with auditory prompts/instructions (Figure 10). learning Kinesthetic in SPOC involves practical activities that allow to students learn through hands-on experience and practice. For example, kinesthetic students may engage in drag-drop activities as part of lecture notes outside of class [45]. additionIn, project-based learning and online collaborative activities can be used to engage students in active and activity-based learning experiences [63]. Students with kinesthetic learning preferences tend to understand material better through practical sessions, case studies or computer simulations [39]. In the context of nursing education, problem-based learning involving case studies and simulation labs can also enhance kinesthetic students' understanding [2]. Thus, SPOCs are designed to provide interactive and practical learning experiences which can enhance kinesthetic students' engagement and understanding [28].

The Small Private Online Course (SPOC) incorporates assignments tailored to students' visual, auditory, and kinesthetic learning styles (Figure 11). Visual learners benefit from animations, hypertext, and videos [12]. Their assignments include solving engine diagram

Figure 7. *Application of Station Rotation Learning Strategy in SPOC*

Figure 8. *The Flip-Interactive Book feature in SPOC*

Figure 9. *Visual Learning*

Figure 10. *Auditory and Kinesthetic Learning*

Figure 11. *Implementation of Learning Assignments Based on Students' Learning Style Preferences*

problems, completing calculation-based tables, redrawing engine diagrams, and analyzing causal effects of crankshaft RPM changes. Auditory learners engage with audio- based lectures and discussions [46]. Their task involves listening to an audio explanation of engine torque and power, performing calculations, and recording an oral explanation of their results to submit via SPOC. Kinesthetic learners participate in hands-on activities, such as drag-and-drop exercises and physical visualization tasks [45]. Their assignment requires using materials like polystyrene foam boards to create power number visualizations.By aligning assignments with learning preferences, instructors can enhance engagement and learning effectiveness [46]. Additionally, integrating learning styles into online course design ensures diverse student needs are met, improving content delivery [46].

4.9 Formative Test Results

The results of the test of effectiveness SPOC development based on student learning style preferences showed a significant increase in both the Small Group and Field Tests. In the Small Group test, the difference in scores before and after treatment had an average (Mean) of 28.82 with a standard deviation of 28.26, while in the Field Test, the average score increase was namely higher, 36.57 with a standard deviation of 25.43. The error of the mean smaller standard in the Field Test (4.30) compared to the Small Group (4.85) indicates a more stable data distribution. interval The 95% also confidence washigher in the Field Test (27.84-45.31) than the Small Group (18.96-38.68), indicating that the effectiveness of the treatment was more consistent in the testwider . The values t-calculatedin the Small Group (5.947) and Field Test (8.508) were both greater than the t-tables (1.692 and 1.690), indicating that the improvement in learning outcomes was statistically significant (p = 0.000). This difference indicates that the implementation of SPOC was more effective on a larger scale, suggesting that a learning style preference-based approach can deliver stronger results in a wider learning environment.

5. Discussion

5.1 Relationship between Research Results and Previous Studies

The results of this study support previous findings that Small Private Online Courses () SPOCsMOOCs have the potential to improve learning blended learning effectiveness, particularly through a approach that incorporates offline online interactions and provides a more personalised and interactive learning experience compared to [26, 27, 37, 44]. This study extends the scope by tailoring SPOCs to students' learning style preferences (Visual, Auditory, Kinesthetic), which has not been widely discussed in previous studies. This finding is in line with the research of Ti Hu et al. (2022) [27] which showed that a SPOC-based teaching approach can increase students' learning motivation, this is validated from the results of the test construct validation showed that this approach is very feasible to implement and has significant

Table 5. *Small Group Effectiveness Test Results*

Paired Test	Samples	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	After SPOC Treatment - Before SPOC Treatment	28.82353	28.25905	4.84639	18.96348	38.68358	5.947	33	.000

Table 6. *Field Test ResultsEffectiveness*

Paired Test	Samples	Mean	Std.Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	After SPOC Treatment - Before SPOC Treatment	36.57143	25.43074	4.29858	27.83566	45.30719	8.508	34	.000

meaning, reinforcing the finding that SPOC can increase learning effectiveness through a more personalised pathway [23,27]. Given the previously researched student activity data-based performance prediction model [27], the development of learning style preference-based SPOC may be a more effective personalisation strategy in supporting more adaptive learning.

In additionIn addition to , this study reinforces the findings that SPOC can improve student learning outcomes through more flexible and interactive learning learning mechanisms [31, 44]. reinforcing, this study also provides scientific justification for the differences found with previous studies, especially related to the effectiveness of that can be measured meaningfully using Borg & Gall and Dick And Carey on the methodologies development of personalised SPOC in SPOC. While previous research highlighted that SPOC increased learning participation and course completion rates [54], this study showed that adaptation based on students' learning styles further enhanced their learning experience. Based on similar N-Gain values in both classes (0.64-0.66), the results of this study support the idea that SPOC provides a moderate improvement in learning outcomes, as also found in previous research regarding the effectiveness of the flipped classroom model in SPOC [6]. In addition, it supports the finding that the online-to-offline (O2O) teaching method in SPOC is more effective than traditional teaching methods [35], as students can learn more flexibly according to their learning styles. . However, this study shows that the effectiveness of SPOC depends not only on the learning structure combined with face-to-face classes, but also on the adaptation of materials and methods according to students' learning styles

The results observation show that the social interaction-based learning method and simulation of real conditions in SPOC can improve students' attitude and interest in learning. This finding is in line with Zhang et al. (2024) [64] and Sun et al 2019 [51], who highlighted increased cognitive, emotional, and behavioural engagement through similar approaches [64], SPOC provides a more immersive and flexible learning experience [51]. However, this study challenges the views of Freitas & Paredes (2018) who emphasised the dominance of social values in traditional online course design [13]. Instead, a learning style preference-based approach enables SPOC instructional design to be more effective in improving learning outcomes. additionIn, this research extends the study of SPOC by emphasising personalisation, flexibility, and students' self-learning motivation [57, 58, 59].

5.2 Future Research Recommendations

Further research on the Prototype SPOC Pelita Pendidikan is recommended to integrate automotive formulas in power numbers as material material enrichment according to expert input. theory Richard Mayermedia 's 's cognitive can be a reference in media , development and assessmentwhile Robert Maribe BranchADDIE method is recommended for a more systematic learning design. platform The also needs to adapt learning to students' learning style preferences (Visual, Auditory, Kinesthetic) based on Branch'2024 .s inventory and add Reading elements to enrich the learning experience of class X Engineering Automotive Light Vehicle students in the odd school year

6. Conclusion

6.1 Research Conclusion

Based on the results of the formative test which includes Expert Review, One To One, Small Group, and Field Test, the Pelita Pendidikan Small Private Online Course (SPOC) Prototype oriented to student learning style preferences is declared feasible and effective to use. This is evidenced by the results of the trial on class X Engineering in students of Automotive Light Vehicle the odd 2024 which school year shows that this prototype is able to meet the learning needs of students according to their learning style, improve understanding of the material, and support the learning process optimally.

6.2 Acnknowledge

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6.3 Declaration of interest statement

I declare that there is no conflict of interest in this research. This study is conducted independently for academic purposes, aiming to develop a Learning Style-Oriented Small Private Online Course (SPOC) with Norm-Referenced Testing (NRT) integration to enhance learning effectiveness.

Author Statements:

- **Ethical approval:** The conducted research is not related to either human or animal use.
- **Conflict of interest:** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper
- **Acknowledgement:** The authors declare that they have nobody or no-company to acknowledge.
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- **Data availability statement:** The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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