

ARTICLE

## Development of Integrate Differentiated Learning Modules on Basic Laws of Chemistry Phase E

Nazhifah Athaya<sup>a</sup>, Rahadian Zainul<sup>b</sup>

<sup>ab</sup>Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang, Jl. Prof. Dr. Hamka, Air Tawar Barat, Padang Utara, Padang, West Sumatera, Indonesia, 25171

\*Corresponding email: [nazhifahathaya@gmail.com](mailto:nazhifahathaya@gmail.com)

### ABSTRACT

This research aims to produce an integrated differentiated learning module on the basic laws of phase E chemistry that is valid and practical. This type of research is Research and Development (R&D) with a four-D (4D) development model which consists of four stages; (1) define, design, develop, disseminate. This research is limited to the development stage of validity testing and practicality testing. The validity test was carried out by 5 validators and the practicality test by 2 teachers at SMAN 4 Pariaman and 35 class X students. The research instrument used was a validity and practicality questionnaire which was analyzed using Aiken's V formula. Data analysis obtained an average validity of 0,9 with valid categories. Based on the practicality test of teachers and students respectively, percentages of 0.9 and 0.94 were obtained in the very practical category. Based on the research results, it can be concluded that the integrated differentiated learning module on the basic laws of phase E chemistry is valid and practical.

### ARTICLE HISTORY

**Submission:** May 29, 2024

**Received:** May 30, 2024

**Accepted:** May 31, 2024

### Citation:

Athaya. Nazhifah and Zainul. Rahadian, "Development of Integrate Differentiated Learning Modules on Basic Laws of Chemistry Phase E," *Chemistry SMART*, vol.3, no.1, pp. 55-64

### Keywords:

Development Module; Differentiated learning; basic laws of chemistry; 4-D models.

*This is an open access article under the [CC-BY](https://creativecommons.org/licenses/by/4.0/) license.*



This is an open access article distributed under the Creative Commons 4.0 Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. ©2024 by author.

### Corresponding Author :

Nazhifah Athaya

Faculty of Mathematics and Natural Science, Padang State University, Indonesia

Email : [nazhifahathaya@gmail.com](mailto:nazhifahathaya@gmail.com)

## **1. Introduction**

The role of educators in implementing independent learning is very important [1], educators must be able to align the content of the curriculum with the needs of students, provide and design appropriate teaching tools [2], one of the teaching tools needed is modules. A module is a program package that is prepared and designed in an integrated, systematic and detailed manner as independent learning material to help students master their learning objectives. In this way, students can learn at their own pace. Educators must pay attention to the balance between creativity, [3] taste and intention, thus it can be concluded that education is the process of forming humans into real human beings.

Modules as teaching materials must be adapted [4] to the demands of the curriculum, taking into account the needs of students, namely modules that are in accordance with the characteristics of the teaching material, characteristics of students and their social environmental background [5]. The module developed must be able to increase student motivation [6]. The module is structured in such a way that it is able to present good and interesting material for students [7]. The material is not limited to text only, but is also accompanied by images, audio and video [8]

Developing modules that are tailored to the needs of students aims to ensure that the learning we provide is meaningful [9], there are no gaps between students so that the needs of each student can be met, thus the appropriate learning to do is differentiated learning [10]

Differentiated learning is a teacher's attempt to adapt the learning process to students' individual learning needs [11]. Thus, we can understand that to meet students' learning needs, a teacher must be able to design appropriate learning [12], this is in line with the PGP module which states that "Differentiated learning must be rooted in meeting students' learning needs and how teachers respond to these learning needs [13]." One way we can see the learning needs of students is from the learning profile, namely the student's learning style [14]. Teachers as learning leaders must strive consistently to meet students' needs in developing module teaching materials, namely by implementing differentiated learning [15]

Based on the results of distributing questionnaires carried out in two schools, namely SMAN 4 Pariaman and SMAN 1 Sungai Limau to teachers and class X students for each school. The results of data processing from the questionnaire given to teachers, obtained information that at SMAN 4 Pariaman the independent curriculum has been implemented, teachers teach using modules developed by themselves, some students are interested in studying the modules, some students can achieve learning objectives, the modules used have not been considered learning style, the material presented has pictures, no diagrams, no graphs, no sound video links, no experimental activities, the teacher knows and really agrees with differentiated learning but has not developed an integrated differentiated learning module.

At SMAN 1 Sungai Limau, information was obtained that the independent curriculum had been implemented, teachers used modules available on the internet, some students were interested in studying the modules, some students were able to achieve the learning objectives, the modules used did not take into account learning styles, the material presented had pictures, no there are diagrams, no graphs, no sound video links, no experimental activities, teachers are familiar with differentiated learning but have not developed integrated differentiated learning modules.

Based on the results of data processing from the questionnaire given to students, information was obtained that it was not easy for students to understand chemical material regarding the basic laws of chemistry, this was reflected in 53% of students at SMAN 4 Pariaman, and 60% of students at SMAN 1 Sungai Limau. %, as well as regarding students' interest in studying this basic chemical legal material, it was found that 60% of students at SMAN 4 Pariaman were not interested, followed by SMAN 1 Sungai Limau 53%, next regarding the achievement of learning objectives, 47% of students at SMAN 4 Pariaman has not yet been reached, followed by SMAN 1 Sungai Limau which is at 53%. One of the reasons for the percentage of student achievement in the two schools above is because the modules used by teachers do not provide learning activities that suit the students' learning styles [16], the modules only present material in the form of pictures for the needs of a visual learning style, while for students who have a learning style auditory and kinesthetic are not yet provided [17].

Based on the data from teachers and students above, it can be concluded that teachers have not implemented differentiated learning, one of which is of course related to how teachers develop modules as teaching tools used in learning so that the learning provided can meet the needs of each student according to their style. learn what he has.

Based on the explanation of the problem above, the author has developed a module related to differentiated learning, with the title "Development of an Integrated Module for Differentiated Learning on Legal Material - Basic Laws of Chemistry Phase E.

## 2. Experimental

The development model used in developing integrated differentiated learning modules on the basic laws of phase E chemistry is the 4-D model. This 4-D model consists of four stages, namely the defining stage, designing, developing and disseminating [26].

Each stage can be explained as follows: Define stage (definition), the definition stage consists of: front-end analysis, student analysis, task analysis, concept analysis and determining learning objectives. Design stage (design), the design stage consists of four activities, namely: Preparation of test standards, media selection, format selection, and initial design. Development The module that has been designed needs to be refined, therefore at this development stage it is necessary to test the module. The testing carried out consisted of expert appraisal followed by revision and development trials. Disseminate this stage is the final stage in development. The purpose of distribution or publication is to show

the product produced during the development stage. However, in this research the dissemination stage was not carried out due to time and cost limitations.

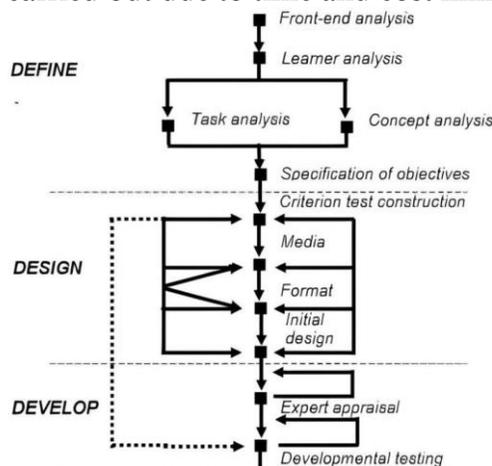


Figure 1. 4-D Development Model View

Data analysis techniques for each research data can be described as follows:

The validity analysis technique is based on Boslaugh's modified categorical assessment. The validator receives statements, providing a rating for each statement. The sheet provided is designed as a questionnaire and ultimately provides the validator with the opportunity to determine the results of the evaluation provided[18].

Practicality analysis techniques, practicality is the level of practicality of the research product used by students. This activity was carried out to determine the extent of the benefits, convenience, time efficiency of use, and benefits of media by students[19].

### 3. Results and discussion

#### 3.1 Validity

The validity test was carried out by 5 experts, namely 3 lecturers from the UNP chemistry department and 2 teachers from SMAN 4 Pariaman. The components assessed at the validation stage include 4 components, namely the content feasibility component, construction feasibility component, linguistic component, graphic component [20] The overall validation results by the validator can be seen in table 1.

Table 1. The Overall Validation

Aspect Assessed	V	Category
Eligibility content	0,9	Valid
Construction feasibility	0,87	Valid
Linguistic component	0,93	Valid
Graphic component	0,89	Valid

The content feasibility component has an average V value of 0.9 with a valid category. Having a valid category means that the content of the module developed is in accordance with the demands of learning outcomes in accordance [21] with the decision of the head of the standards, curriculum and education assessment body of the Ministry of Education, Culture, Research and Technology No. 22 concerning learning outcomes, as well as learning objectives and the flow of learning objectives to be achieved. by students is appropriate. Apart from that, this module which is integrated with differentiated learning can increase students' knowledge insight more quickly [22] because the module is developed in accordance with the 3 learning styles of students following the students' learning needs [23].

The construction feasibility component has an average v value of 0.87 with a valid category. This states that the module developed is systematic, starting from subject review, introduction, learning activities, sample questions, formative tests and tests. Summative [27] The language component of the module has an average V value of 0.93 with a valid category. This shows that the language used in using the module is in accordance with the KBBI and is clear and easy to understand and consistent in using symbols [21].

The graphic component of the module has an average V value of 0.89 with a valid category. This shows that the module developed has images that are easy to observe clearly, type and size of letters, layout, color and design used. in module development it is clear and interesting [24].

Based on the results of data analysis from all aspects of the integrated differentiated learning module on the basic chemical law material that was developed, the entire module that has been developed has a validity level of 0.9 in the valid category.

### 3.2 Practicality

The practicality test was carried out using an existing practicality questionnaire. The practicality questionnaire was given to two chemistry teachers at SMAN 4 Pariaman and thirty-five Phase E students at SMAN 4 Pariaman. In the practicality test carried out by teachers and students, there are three main aspects that are assessed, namely, the convenience aspect, the time efficiency aspect and the benefits aspect. The results of the practicality data will be calculated with the final result in the form of a percentage.

- a. Results of the practicality of the average teacher response can be seen in table 2.

Table 2. Practically of the teachers response

Aspect Assessed	NP	Category
Easy to use	90%	Very Practical
Time Efficiency	85%	Practical
Benefits	95,71%	Very Practical

- b. Results of the practicality of the average student respons can be seen in table 3.

Table 3. Practically of the student response

Aspect Assessed	NP	Category
Easy to use	94,85%	Very Practical
Time Efficiency	92,85%	Practical
Benefits	94,04%	Very Practical

Based on the results of processing the practicality questionnaire on the aspect of ease of use by teachers and students, the respective average scores were 90% and 94.85% with the practicality category being very practical. This shows that the use of this integrated differentiated learning module has clear instructions for use so that teachers and students know the steps that must be carried out in learning [28]. The material presented in the module is clear and simple and uses a typeface that is easy to read [29].

Based on the aspect of time efficiency by teachers and students, average scores were obtained, respectively, namely 85% and 92.85% in the categories of practical practicality and very practical.

Where learning using modules can make learning time more efficient and [30]. states that the aim of learning with modules is to open up opportunities for students to learn at their own pace [31]. Where students have different abilities.

Based on the benefits aspect for teachers and students, the average scores were 95.71% and 94.04% respectively with the practicality category being very practical. From the answers given by teachers, this module can help teachers reduce the teacher's workload in explaining the material [32]. so that teachers can monitor students' learning activities. Based on the students' answers, it can be seen that this module can also help students understand the subject matter well and make students more independent in learning [33]. and according to their respective learning methods and styles. In accordance with [34]. that modules must be able to be used as teaching materials as a substitute for the teacher's function.

The results of the practicality assessment of teachers and students show that the integrated differentiated learning module developed is easy to use, learning time is more efficient and students easily understand the material clearly, increasing students' interest in learning in accordance with [35]. stating that the pictures support and clarifying the content of the material is very necessary in making modules because it adds interest and reduces students' boredom in viewing and studying the module. Based on the results of processing the practicality questionnaire on the aspect of ease of use by teachers and students, the respective average scores were 90% and 94.85% with the practicality category being very practical. This shows that the use of this integrated differentiated learning module has clear instructions for use so that teachers and students know the steps that must be carried out in learning [25]. The material presented in the module is clear and simple and uses a typeface that is easy to read [21]

#### 4. Conclusion

Based on the objectives and results of the research, it can be concluded that the integrated differentiated learning module on the basic laws of phase E chemistry can be developed using a 4-D model with a valid and very practical category. The integrated differentiated learning module on the basic laws of phase E chemistry material that was developed has a V value of 0.9 in the valid category, then the average value of practicality by teachers is 90.24% and the average value of practicality by students is 93.92% with each category is very practical. The results of the practicality assessment of teachers and students show that the integrated differentiated learning module developed is easy to use, learning time is more efficient and students easily understand the material clearly increasing students' interest in learning.

## References

- [1] J. D. Robinson and A. M. Persky, "Developing self-directed learners," *Am. J. Pharm. Educ.*, vol. 84, no. 3, pp. 292–296, 2020
- [2] J. Li and R. Wang, "Determining the role of innovative teaching practices, sustainable learning, and the adoption of e-learning tools in leveraging academic motivation for students' mental well-being," *BMC Psychol.*, vol. 12, no. 1, pp. 1–15, 2024
- [3] E. O. Bereczki and A. Kárpáti, "Technology-enhanced creativity: A multiple case study of digital technology-integration expert teachers' beliefs and practices," *Think. Ski. Creat.*, vol. 39, no. January, 2021
- [4] K. Dolenc and B. Aberšek, "TECH8 intelligent and adaptive e-learning system: Integration into Technology and Science classrooms in lower secondary schools," *Comput. Educ.*, vol. 82, pp. 354–365, 2015
- [5] S. Sumarni and S. L. Fitri, "Developing Interactive Multimedia to Improve Language Literacy in Early Childhood," pp. 155–160, 2023
- [6] S. A. Sotiriou and F. X. Bogner, "education sciences How Creativity in STEAM Modules Intervenes with Self-Efficacy and Motivation," *Educ. Sci.*, vol. 2, no. 1, pp. 2–15, 2020.
- [7] A. Rose M. Padugar, R. E. Gloria, and M. Eva E. Diongco, "E-Learning Materials in Earth and Life Science for Struggling Learners," *Int. J. Res. Publ.*, vol. 108, no. 1, pp. 236–261, 2022
- [8] S. Biswas, E. Kruijff, and E. Veas, "View recommendation for multi-camera demonstration-based training," *Multimed. Tools Appl.*, vol. 83, no. 7, pp. 21765–21800, 2024
- [9] M. Senevirathne, D. Amaratunga, R. Haigh, D. Kumer, and A. Kaklauskas, "A common framework for MOOC curricular development in climate change education - Findings and adaptations under the BECK project for higher education institutions in Europe and Asia," *Prog. Disaster Sci.*, vol. 14, no. September 2021, p. 100222, 2022
- [10] M. Pozas, V. Letzel-Alt, and S. Schwab, "The effects of differentiated instruction on teachers' stress and job satisfaction," *Teach. Teach. Educ.*, vol. 122, p. 103962, 2023,
- [11] T. M. Schipper, R. M. van der Lans, S. de Vries, S. L. Goei, and K. van Veen, "Becoming a more adaptive teacher through collaborating in Lesson Study? Examining the influence of Lesson Study on teachers' adaptive teaching practices in mainstream secondary education," *Teach. Teach. Educ.*, vol. 88, p. 102961, 2020
- [12] A. Koskinen, J. McMullen, M. Hannula-Sormunen, M. Ninaus, and K. Kiili, "The strength and direction of the difficulty adaptation affect situational interest in game-based learning," *Comput. Educ.*, vol. 194, no. November 2022, p. 104694, 2023

- 
- [13] R. M. van der Lans *et al.*, “Beyond the linear standard: What circular models can teach us about teachers’ continuing professional learning needs in Australia, England, Japan and The Netherlands,” *Teach. Teach. Educ.*, vol. 138, p. 104413, 2024
- [14] A. E. Labib, J. H. Canós, and M. C. Penadés, “On the way to learning style models integration: a Learner’s Characteristics Ontology,” *Comput. Human Behav.*, vol. 73, pp. 433–445, 2017
- [15] X. Xin, Y. Shu-Jiang, P. Nan, D. ChenXu, and L. Dan, “Review on A big data-based innovative knowledge teaching evaluation system in universities,” *J. Innov. Knowl.*, vol. 7, no. 3, p. 100197, 2022
- [16] K. Alhazmi, “Navigating Literacy Challenges : A Comprehensive Study on Reading Difficulties and Vocabulary Development in Applied Linguistics,” vol. 10, pp. 788–809, 2023.
- [17] A. Rashad Sayed, M. Helmy Khafagy, M. Ali, and M. Hussien Mohamed, “Predict student learning styles and suitable assessment methods using click stream,” *Egypt. Informatics J.*, vol. 26, no. April, p. 100469, 2024
- [18] T. T. N. Nguyen, “Developing and validating five-construct model of customer satisfaction in beauty and cosmetic E-commerce,” *Heliyon*, vol. 6, no. 9, p. e04887, 2020
- [19] M. D. Denkinge, U. Lindemann, S. Nicolai, W. Igl, M. Jamour, and T. Nikolaus, “Assessing physical activity in inpatient rehabilitation: Validity, practicality, and sensitivity to change in the physical activity in inpatient rehabilitation assessment,” *Arch. Phys. Med. Rehabil.*, vol. 92, no. 12, pp. 2012–2017, 2011
- [20] C. Perret, S. Poiraudou, J. Fermanian, M. M. Lefèvre Colau, M. A. Mayoux Benhamou, and M. Revel, “Validity, reliability, and responsiveness of the fingertip-to-floor test,” *Arch. Phys. Med. Rehabil.*, vol. 82, no. 11, pp. 1566–1570, 2001
- [21] F. Daryanes, D. Darmadi, K. Fikri, I. Sayuti, M. A. Rusandi, and D. D. B. Situmorang, “The development of articulate storyline interactive learning media based on case methods to train student’s problem-solving ability,” *Heliyon*, vol. 9, no. 4, p. e15082, 2023
- [22] M. H. Al-khresheh, “Bridging technology and pedagogy from a global lens: Teachers’ perspectives on integrating ChatGPT in English language teaching,” *Comput. Educ. Artif. Intell.*, vol. 6, no. March, p. 100218, 2024
- [23] C. Lwande, L. Muchemi, and R. Oboko, “Identifying learning styles and cognitive traits in a learning management system,” *Heliyon*, vol. 7, no. 8, p. e07701, 2021
- [24] P. Viitaharju, K. Yliniemi, M. Nieminen, and A. J. Karttunen, “Learning experiences from digital laboratory safety training,” *Educ. Chem. Eng.*, vol. 34, no. January 2021, pp. 87–93, 2021
- [25] G. B. Naparan and V. G. Alinsug, “Classroom strategies of multigrade teachers,” *Soc. Sci. Humanit. Open*, vol. 3, no. 1, p. 100109, 2021
-

- [26] Thiagarajan, S., Semmel, D. S. dan Semmel, M. I. 1974. *Instructional Development for Training Teachers of Exceptional Children*. Minnesota: University of Minnesota
- [27] Sudakova, Natalia E., Tatyana N. Savina, Alfiya R. Masalimova, Mikhail N. Mikhaylovsky, Lyudmila G. Karandeeva, and Sergei P. Zhdanov. 2022. "Online Formative Assessment in Higher Education: Bibliometric Analysis" *Education Sciences* 12, no. 3: 209.
- [28] Naparan, G. B., & Alinsug, V. G. (2021). Classroom strategies of multigrade teachers. *Social Sciences and Humanities Open*, 3(1), 100109.
- [29] Daryanes, F., Darmadi, D., Fikri, K., Sayuti, I., Rusandi, M. A., & Situmorang, D. D. B. (2023). The development of articulate storyline interactive learning media based on case methods to train student's problem-solving ability. *Heliyon*, 9(4), e15082.
- [30] Moustapha, M., Marelli, S., & Sudret, B. (2022). Active learning for structural reliability: Survey, general framework and benchmark. *Structural Safety*, 96, 102174.
- [31] Md Abdullah Al Mamun, Gwendolyn Lawrie, Tony Wright. (2020). Instructional design of scaffolded online learning modules for self-directed and inquiry-based learning environments, *Computers & Education*, Volume 144
- [32] Moldavan, A. M., Edwards-Leis, C., & Murray, J. (2022). Design and pedagogical implications of a digital learning platform to promote well-being in teacher education. *Teaching and Teacher Education*, 115, 103732.
- [33] Md Abdullah Al Mamun, Gwendolyn Lawrie, Tony Wright. (2022). Exploration of learner-content interactions and learning approaches: The role of guided inquiry in the self-directed online environments, *Computers & Education*, Volume 178,
- [34] Goldin, T., Rauch, E., Pacher, C., & Woschank, M. (2022). Reference Architecture for an Integrated and Synergetic Use of Digital Tools in Education 4.0. *Procedia Computer Science*, 200(2019), 407–417.