



Personalized Learning Mode Research Based on Intelligent Technology in Adult Education and Occupational Training

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Abstract: Today, when people are smarter than ever, they learn in a lot of different ways. There are a lot of people who choose to learn on the internet. Even if there are more great training materials available, students may still have issues, such as having too much knowledge. A multi-algorithm shared, changeable learning route suggestion model is suggested as a way to fix this issue and help students who use online learning tools. The learner model is built around four points of view: the student's thought level, their ability to learn, their preferred learning style, and their energy for learning. The second step is to use the association rule method to plan how trainees will learn each piece of information and make a list of them.

Keywords: Learner Model; Association Rule Algorithm; Swarm Intelligence Algorithm; Personalized Recommendation; Learning Path Generation

1. Introduction

1.1 Interests And Learning

Since the late 1800s, journals have been interested in finding out how hobbies and learning processes are linked. But in the last few decades, there have been a lot more study studies that try to figure out this relationship better (Boekaerts & Boscolo, 2002; Hidi, 2006; Krapp, 2007). Theorists, researchers, and education professionals are becoming more aware of the fact that the students are the most important part of teaching and learning. They need to be involved in their own school activities and learn in a way that is meaningful to them (Barron, 2006; Coll, 2016, 2018).

It has been shown that a learner's interests greatly affect their ability to concentrate (Hidi, 2001), their desire to learn (Järvelä & Renninger, 2014), their interest (Ainley & Ainley, 2011), the goals they set (Harackiewicz et al., 2000; Ito et al., 2013), their cognitive functioning (Hidi, 2001), their understanding and the depth of their learning (Dewey, 1913; Hidi & Harackiewicz, 2000; Ito et al., 2013), and their performance (Maurice et al., 2014).

When you look closely at these and other studies, you can see that writers use a lot of different words to talk about learning skills. Because the different academic methods are so different, it is hard for them to talk to each other because the idea of interest is based on many different ideas that aren't always made clear. Because people don't agree on anything, it's also hard to make and use analysis tools that scientists and education workers can both use.

So, since the main point of this paper is to help you figure out how to teach in a way that works with and around students' interests, it seems important to talk about the theoretical ideas that support the different ways that authors describe interests.

1.2 Theoretical Approaches to Interests

There are a few key points that all meanings agree on when they look at the literature on learners' interests from both a theory and an empirical point of view. Most of them: (1) believe that interests involve a specific type of connection between a person and an object of interest (Akkerman & Bakker, 2019; DiGiacomo et al., 2018; Krapp, 2007); (2) talk about the person's mental, emotional, behavioral, or cognitive features (Ainley, 2006; Hidi & Renninger, 2006); and (3) stress the involvement that comes with an interest in a certain thing (Azevedo, 2011). These subjects are too broad and too important for this paper to cover, so they will not be included.

But these meanings are very different if you look at how they were thought of in the first place. There are some links between these because they come from having different ideas about the philosophy of interests. What is the object of interest (narrow or broad?); What kind of interest is it (social or individual?); Is it stable or does it change over time?; How does education change interests? (Identification or reconstruction?); And Is there a one-way or two-way link between interests that come from different places?

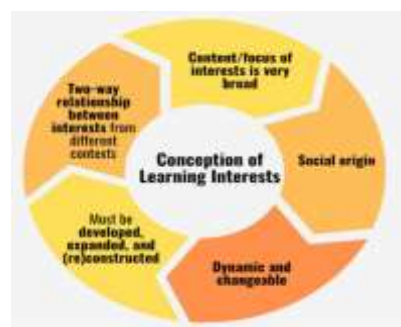


Figure 1: What Makes Hobbies That Help You Learn Special

1.3 The Focus of The Object of Interest

Various theories say that interests are a person's strong attachment to a certain thing, but the types and sizes of things that people are interested in are very different. After reading a lot of literature, we came up with topic-centered, domain-centered, and practice-centered views based on the topics that interested us. That person says "an object of interest can refer to concrete things, a topic, a subject-matter, an abstract idea, or any other content of the cognitively represented life-space" (p. 8.8). In this case, the point of view is focused on the matter.

1.4 The Nature of Interests

The second way that different theory methods are different is in how they describe interests: as personal or social. This way of thinking about hobbies as personal traits or tendencies of the person is different from other ways of thinking about them. These other ways of thinking focus more or less on the role that people's social situations play. So, some studies think that interests come from the way a person's traits interact with their social environment. These studies look at how a person's choices, daily habits, or membership in certain communities of practice are very important in creating and maintaining interests.

1.5 The Consistency of Interests

One different idea that is linked to the first one is the idea that people's interests don't change over time. There are two types of definitions of interest: those that see interests as "a relatively stable tendency to occupy oneself with an object of interest" (p. 9) and those that see interests as "a state or an ongoing process during an actual interest-based activity" (p. 9) and study current engagements.

1.6 How Hobbies That Come Up in Different Situations Are Related To Each Other

The last thing that was different between the authors was how they thought hobbies that started in different school and non-school settings related to each other. Some methods are based on the idea that there is only one way to relate to students.

1.7 Personalization of School Learning

Personalization, difference, and individualization are all words that can mean the same thing. But there are some differences between the three ideas, which is why Bray says that different ways of personalizing learning can be put on a spectrum.

Some educational practices, like personalizing learning and those that come from a socio-constructivist perspective, need to be designed and developed in a way that makes them good for teaching. The student should be at the center, there should be a lot of planning and unity between the design and how it is used, there should be a lot of tools to help students learn, the plan should be long-term and organized, and there should be (Fig. 2).



Figure 2: Things That Make Good Teaching Practices

The idea behind personalized learning techniques, according to Coll, is that these techniques should help students find more meaning and value in the things they learn at school and elsewhere. Some people believe they learn best when: (a) something new is revealed about their past that helps them understand themselves better; (b) something helps them understand and act on their everyday reality; and/or (c) something helps them see themselves in the future personally, socially, or professionally by making action plans and drawing up scenarios that involve them.

Coll (2018) says that one or more of the following personalization techniques should be used in school to give learning meaning and worth for each student: (a) let students choose what they want to learn; (b) let them make choices; (c) connect what they learn in school and what they learn outside of school; (d) use community resources and learning opportunities; (e) pick content that is socially and culturally relevant; and (f) let them think about how they learn and who they are as learners (Fig. 3).



Figure 3: Ways To Make School Learning More Personalized

Then, we'll focus on the first technique—working with students based on their interests—and talk about how it can be used, including how it might make it easier to include the other techniques in the planning of an educational practice.



1.8 Personalization and What Kids Are Interested In

Because of this, personalization means that each student can be in charge of their own learning. For example, to make schoolwork more valuable and important to them, they might show off their choices and hobbies. One important thing to keep in mind about this theory is that it's not enough to just find out what students are interested in; you need to use those hobbies as learning tools.

1. By encouraging students to think about how they learn and who they are as learners, teachers can help students (re)build their interests. It has been shown that interventions that force students to think help them understand and grow their hobbies.
2. Students should be able to choose what, how, where, when, and with whom to learn based on their own hobbies. Teachers should encourage and support this. Some study also shows that decision-making and interest growth are connected in a two-way way.
3. Students should be able to choose what, how, where, when, and with whom to learn based on their own hobbies. Teachers should encourage and support this. Some study also shows that decision-making and interest growth are connected in a two-way way.
4. Including socially and culturally important material in lessons and activities helps students value the things they are interested in and/or find new things they are interested in.
5. To help students find new hobbies, teachers should think about and use the learning tools and possibilities that are available in the community and/or on the Internet. This approach uses the fact that learning tools are spread out and is based on the idea that creating and maintaining hobbies depend on the social and financial opportunities that are available.

2. Definitions Of Personalized Learning

According to the U.S. Department of Education (2010, 2016), personalized learning is when the pace of learning and the way the students are taught are adjusted to meet their specific needs. Depending on the needs of the students, learning goals, teaching methods, and lesson material (including the order in which it is taught) may all be different. Also, students choose learning tasks that are important and relevant to them based on their hobbies and often start them on their own (2016, p. 7). It means changing the speed of the lesson based on what the student needs to learn. Diversity means changing the way the lesson is taught to fit the student's learning style (U.S. Department of Education, 2010). The most important thing to think about when it comes to PL in the classroom is the third line, which says that it should be useful, relevant, interest-driven, and self-initiated. This broad definition fits with PL research in educational psychology, which looks at how interest-based connections affect motivation and learning (e.g., Bernacki & Walkington, 2018; Cordova & Lepper, 1996; Reber et al., 2009; Walkington, 2013). It also looks at utility value interventions (e.g., Hulleman et al., 2010) and ways to teach that give students choice or agency (e.g., Patall, 2013).

The authors of the 2014 book *Making Learning Personal* used PL in a similar way: "Students take an active role in their own learning in a personalized learning environment." This is something that schools have done a lot. They can pick what they learn based on how they learn best. Kids can show what they know and have learned in a number of different ways. Students take charge of their own learning and help make plans for it in a learner-centered setting. "The teacher shows them the way" (p. 14). There are a lot of similarities between this definition and the DOE definition. This definition gives the student a clear sense of ownership that puts freedom and control first. This isn't always the case, though, in meanings of PL. *EduVariety Rhode Island* (2017) looked at different meanings of PL and found 8 themes that were present in all of them: personalization, diversity, alignment with standards, student ownership, social integration, connection to student interests, flexibility, and constant feedback assessment. In real life, PL could be seen as a bunch of different groups that include some or all of these things.



So, Cuban (2018) suggests looking at PL methods on a scale instead of setting a single, fixed description. He suggests that one end of the spectrum should have teacher-centered lessons that use learning tools (like tracks made by teachers) to teach skills based on standards and are adapted to each student's level of success. There is also the other end of the spectrum, which is student-centered classes. These can include events from different subjects and the community, and students use new tools to create learning experiences that fit their hobbies and talents. As Beese (2019) said, "Educational personalization is best conceived, broadly, as that which occurs in any process that uses information from or about a student to generate educational plans or decisions for that student." These two ends of the range would both fit into this "big tent" meaning of PL. People who study a lot of different types of research are meant to use this meaning of PL. It is also meant to make it easier for researchers working on the creation and review of PL to work together and to get researchers to think about how PL can be used in different cultures and ways of doing things. For example, student tracking can be used as PL.

We (Walkington & Bernacki, 2014) also added to this conversation by talking about how PL methods can be different in three dimensions. Theories of learning have something to do with these aspects. At first, PL can happen at different levels of depth. This shows how much the learning tasks and the environment of the learning take into account what the students have already done in real life. One simple way to tailor learning to a student's traits is to include their name or favorite food in a problem-solving task to get their attention. On a deeper level, learning can be based on meaningful learner traits (for example, a course based on a learner's career trajectory; see Alamri and Lowell, this issue); or it can include learner interests in ways that really connect to the content to be learned (for example, having students mathematically model personally relevant data; see Garrett et al., this issue; or having students digitally curate an interest-based collection; see Tsybulsky, this issue).

PL can also happen at different grain sizes, which means that the experience can be tailored to each student individually, in small groups of students who are matched based on certain factors, or in larger groups based on factors that are more general. If you know where a group of students live or what level they are at in reading, you could change a learning task based on big-picture personalization. Personalization with a medium grain size might work for smaller groups of students, like in the course that Alamri and Lowell talk about in this issue, where students do chores that cover four job paths. And small grain size personalization can make sure that each student learns in a way that is just right for them. These goals can be met with flexible technology (McCarthy et al., this issue; Plass, this issue) or by focusing on the skills and hobbies of each student (Garrett et al., this issue, Tsybulsky, this issue).

The last thing that can be different about PL is ownership, which means how much control and choice students have over their learning. Some plans, like iSTART and McCarthy et al. (this issue), don't let students pick because they use technology to make them automatically change. Other plans, like the ones by McGhugh et al. (this issue) and Kallio et al. (this issue), give students a lot of freedom and choice. Tsybulsky (this issue) is one of those who let students choose what they want to learn and take charge of their own learning. They can be different in more ways than just these three. These and other things may, however, help us understand and make sense of the different PL study results. One idea behind PL (Walkington & Bernacki, 2014) is that the learning environment can be changed to help students with the mental, emotional, and social parts of learning. So, the theory does a good job of explaining some design aspects of PL in a way that makes it possible to systematically look at what those aspects mean (e.g., Bernacki & Walkington, 2018).

3. Methodology

The custom learning paths suggestion puts the student at the center and suggests the best learning paths for them based on their brain level, learning style, learning energy, and learning ability. This makes learning more effective. When students are learning online, the learning path that is offered should think about both whether the order of the information points is right for them and whether the process itself is right for them. Multi-algorithm fusion is used in this work to come up with a learning path advice model that can help students get personalized help when they are learning online. This model is mostly made up of two parts, as shown in Figure 1. The first part's goal is

to set up the right way for trainees to learn from the point of target knowledge. The goal of the second part is to help students find their own unique learning paths. These paths are made up of knowledge points and the tools that go with them. The learning material database and the student feature database are combined with swarm intelligence to create a unique learning path.

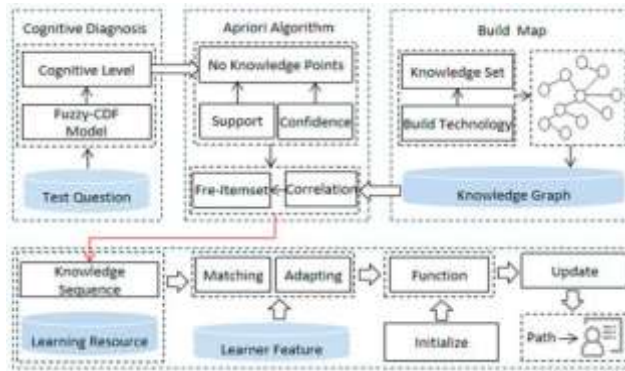


Figure 4: Framework For Suggesting a Personalized Learning Path

The current study only looks at a small amount of data on learning behavior, which makes it hard to build a more complete picture of the student. This means that the personalized learning services will not be as good as they could be. So, this piece looks at data on learning behavior and builds student models from different points of view, which helps with targeted learning and smart management in many ways. Get information about how people learn from online learning tools, then process and store this information so that it can be used to help build student models. This piece talks about learner characteristics from four different points of view: thinking level, learning ability, learning style, and learning energy. It also creates a model of a learner and a foundation for future methods that suggest individual learning paths.

3.1 How Smart You Are Based on Fuzzy-CDF

The cognitive diagnostic model is a way for cognitive scientists to check if students really understand certain things. The DINA model and the DINO model are two useful cognitive diagnostic models that are often used in focused learning. These models prove whether or not students understand what they are being taught and what they have already learned. This helps us get a better idea of how smart the students are. A number between 0 and 1 is given by this model. This number can be used to get a more accurate picture of how well students understand certain subjects. The Fuzzy-CDF model starts with what kinds of traits the learner might have and then works out how skilled the student is. After that, it checks to see how well the person knows the problem and gives them a score for it by adding up the number of mistakes and correct answers.

Fuzzy-CDF is thought to work best when two or more fuzzy sets related to skills meet. This is where the group of students who know all (or most of) the skills and knowledge needed for Problem 1.0 is thought to be. Fuzzy-CDF uses fuzzy numbers to keep track of information that isn't clear, subjective, or quantitative. One way to measure a student's level of knowledge is to look at how much they participate in the fuzzy set that matches their level of knowledge. In other words, a student's level of understanding on an objective question is the sum of all the information points they know. When students are asked subjective questions, η_{ji} is the rough sum of the things they think they know. Here's how the exact method is shown:

$$\eta_{ji} = \bigcap_{1 \leq k \leq K, \theta_{ik}=1} \mu_k(j) \quad (1)$$

$$\eta_{ji} = \bigcup_{1 \leq k \leq K, a_{ik}=1} \mu_k(j) \quad (2)$$

in which $m_{ik}=1$ means that knowledge point k was tested in question i and K means that all of knowledge points were tested in question i . It's not always possible to tell how well a learner really knows something because of guesswork and mistakes. This means that it's not always possible to get a true picture of the learner's abilities.

$$P(X_{ij} = 1 | \theta_i; a_j, b_j, c_j, d_j) = c_j + (d_j - c_j) \frac{e^{1.7a_j(\theta_i - b_j)}}{1 + e^{1.7a_j(\theta_i - b_j)}} \quad (3)$$

b_j stands for judgment, b_j for trouble, c_j for guess, and d_j for mistake. This is how the specific formula is shown:

$$P(R_{ji} = 1 | \eta_{ji}, s_i, g_i) = (1 - s_i)\eta_{ji} + g_i(1 - \eta_{ji}) \quad (4)$$

$$P(R_{ji} = 0 | \eta_{ji}, s_i, g_i) = N(R_{ji} | (1 - s_i)\eta_{ji} + g_i(1 - \eta_{ji}), \sigma^2) \quad (5)$$

where V_{ji} displays the learner's score on question i and s_i and g_i display the errors and guesses they made on question i .

3.2 The Ability to Learn Numbers

Ability is a personal psychological trait that helps keep the whole process stable and in check. Learning ability is the mental state that allows students to finish learning tasks, gain information, and reach their learning goals. In standard learning tasks, not many experts fully think about the effects of differences in how people learn and how their knowledge and behavior affect each other. In the area of smart education, experts have slowly been able to find out useful information about how well students learn. looked at two parts of a learner's ability to learn: their desire to learn and their cognitive skill.

The above study was used to write this paper, which suggests the learning ability S . This works well for the model that suggests the best way to learn. They can learn anything, which shows how well they can do everything. There are four parts to a learner's ability to learn: their thinking ability ($S1$), their ability to be flexible ($S2$), their ability to handle their knowledge ($S3$), and their ability to think through and solve problems ($S4$). How well a person can learn is shown by $S_i = (S1+S2+S3+S4)/4$, where S is a number that goes from 0 to 1. A learning ability T_i of 0.3 to 0.7 is average, and a learning ability S_i of 0.7 to 1 is very good.

Executive Skills

The level of executive ability shows how well a student can finish a task on time. How well kids understand something will depend on how much it's worth, which in turn will depend on how well they do in school. This paper mostly measures brain functioning and figures out how well students are doing on their learning assignments. This is how the specific formula is shown:

$$S_i^1 = \frac{\sum_{j=1}^n \left(\frac{\sum_{k=1}^m z_{jk}}{m} \right)}{n} \quad (6)$$

where $S1_i$ shows how well the user can do something and wjk shows that the learning is over. Item e that goes with the learning job The number of jobs that trainees need to finish is shown by j , and the number of learning



things that go with each task is shown by m . We can say that $S1i$ is the average value of all the learning jobs that students have finished.

3.3 Adaptive Ability

You can only learn better in this age of clever education if you can quickly and easily change to your learning surroundings. The main things that are used to measure how adaptable learners are in this paper are their ability to focus and connect with others. The amount of time pupils spend logging in and out of the app is used to measure their concentration. The level of contact mostly shows how pupils connect with the app. This is how the specific formula is shown:

$$S_1^2 = \alpha \sum_{j=1}^n \frac{T_j}{\sum_{k=1}^m t_{jk}} + (1 - \alpha) \left(\frac{C_f + C_p + C_x + C_d + C_s}{5} \right) \quad (7)$$

where $S2i$ shows how well the learner can change; This graph shows how long learner e logged in for the n th time; this graph shows how long learner e logged out for the n th time; this graph shows how many times learner \square logged in. m shows the total amount of time off for each time; Xf , LO , Lx , Ld , and Ls show how many comments, likes, groups, posts, and downloads pupils have made on the site. There is a number of 0.6 for the weight factors.

3.4 The ability to manage knowledge

The rate at which learners upload notes, complete exercise questions, and answer questions and answers shows how well they can handle their information and remember what they have learned. This is shown by how often learners upload notes, complete exercise questions, and answer questions and answers. This skill is very important for learning because it helps students remember what they have already learned. This essay mostly measures how good someone is at managing information by finding out how often they post notes, finish tasks, and answer questions. This is how the specific formula is shown:

$$S_i^3 = \frac{1}{1 + e^{-(x_i - \bar{x})}} \quad (8)$$

This number also tells you how well learner i organizes the information they have learned. The rate at which notes are uploaded (u), tasks are finished (e), and questions are answered (d) all show how useful it is. Here's how the exact method is shown:

$$x_i = \frac{\sum_{j=1}^N u_{ij}}{m} + \frac{\sum_{j=1}^N a_{ij}}{n} + \frac{\sum_{j=1}^N v_{ij}}{q} \quad (9)$$

The numbers m , T , and m show how many notes, tasks, and Q&As there are all together. The numbers u , X , and X show how many notes, tasks, and Q&As student i has written for knowledge point j . The whole number of information points is shown by the number N .

3.5 Being Able to Look At Problems And Find Solutions

You have to be able to both think about and solve problems in order to see them and fix them. This skill shows that a person has fully understood what they have learned, and it is a key way to improve their brain power. This paper checks to see how right the students' choices are based on their current level of learning. Here's how the exact method is shown:

$$S_i^4 = c_0 + \frac{(1 - c_0)}{1 + e^{-\left(\frac{\sum_{j=1}^n c_{ij}}{n} - \bar{c}\right)}} \quad (10)$$

S_i^4 is the learner's ability to solve problems and think through them, c_0 is the learner's starting cognitive level, c is the average of all learners' correct rates, and S is the number of test questions. The learner's correct rate for question j is given by $c_{ij} = cTrij/m$, where m is the total number of questions in a set and $cTrij$ is the number of questions that learner i gets right on question j .

3.6 Based on The Felder Silverman Scale, How You Learn

People do things in different ways when they are learning. This is what we call how they learn. You can make learning materials that are more useful and interesting by taking into account how each student learns. Being able to learn in a way that works for each person makes internet learning more tailored to their needs. Felder Silverman's learning style scale has eight different types of learning styles in each of the four groups. There are four types of information processing: perceptual information (natural and active); visual and verbal information input; learning content (ordered and complete); and processing information. A behavior model and set of factors that work for this learning style were made with the help of the study and the Felder Silverman learning style measure. These can be seen below in Table 1.

Table 1: A Table with Numbers For Learning.

Learning Style	B-P	Pattern Quantization	Threshold	
			L<-M	M<-H
	P-V(+)	Posting data of all learning tasks	<2	>5
	PB-V(-)	Reply data of all learning tasks	<10	>30
Active/Meditating	FV-T(+)	(Forum vs)(total course) < 100%	<5%	>15%
	D-A(+)	Discussion amount of learning task	<2	>5
	T-A(+)	Test amount of learned task	<2	>5

The behavior mode on the left ("+") and the behavior mode on the right ("-") in the table change how each group learns most of the time. For instance, the more posts you have, the more likely it is that the learner has a left-hand busy learning style. On the other hand, the fewer comments you have, the more likely it is that the learner has a right-hand quiet learning style. Different types of behavior can change a learner's learning style (L). To figure out what kind of behavior it is, the threshold is split into three groups: if it's in the L-m range, the answer is $O_i \in \{H\}$; if it's in the M-H range, the answer is $i \in \{X\}$; and if it's in any other ranges, the answer is $M_i \in \{M\}$. To sum up, a certain type of behavior M_i of student j can be described as Mji . As stated in the explanation, Mji means

$$P_i^j = \begin{cases} 1, P_i^j = H \\ 0, P_i^j = M \\ -1, P_i^j = L \end{cases} \quad (11)$$

This is how you figure out a learner's learning style based on the amount of behaviour types they show:

$$V_j(C) = \frac{\sum_{i=1}^n P_i^j}{n} \quad (12)$$



Learning Intensity Modelling

When trainees do tasks on the platform, how hard they work at them is called their learning effort. This essay talks about how hard students are learning from three different points of view: their learning interest, their participation, and their action.

Getting Students to Learn

The amount of learning that happens on the site is based on how long students spend learning in tools, tasks, and video pages. This is how the specific formula is shown:

$$c_i = \frac{t_i - miT}{maT - miT} \quad (13)$$

The number c_i stands for “learning engagement,” t_i for “the learners’ input duration on Page i ,” maT for “the upper limit of input duration,” and miT for “the lower limit of input duration.” The data on how long it takes learners to learn from tools, projects, and video pages shows that it takes learners less than 300 minutes. Learners who take less than 20 minutes to learn are not taken into account. So, $maT=300$ and $miT=20$ in this paper. Take part in What trainees do when they do learning tasks on the platform is called participation. Its number worth is based on the number of tests (T), homework turned in (H), and talks made (D). Here’s how the exact method is shown:

$$p = \eta_1 T + \eta_2 H + \eta_3 D \quad (14)$$

The behaviour mode on the left (“+”) and the behaviour mode on the right (“-”) in the table change how each group learns most of the time. This gives us a good sample of tests, homework, and discussions from students. What to Do This number shows how much pupils use the site. It’s made up of posts (👉), forum comments (L), resource shares (V), and likes (L). Here’s how the exact method is shown:

$$a = \eta_1 S + \eta_2 C + \eta_3 L + \eta_4 R \quad (15)$$

Generating Knowledge Point Sequences

One of the most well-known algorithms for connection rules is the apriori algorithm. Agrawal et al. introduced a simple method for finding sets of items that are used a lot in 1993. The apriori algorithm works by using a method called “layer-by-layer search,” which is a series of steps. The first set of items is used to look through the second set of items, and so on. We use the apriori algorithm to look at how well students are learning on an online platform and find the common sets of knowledge points that students don't understand. We then combine this information with a library of knowledge maps to make a plan for the right order of knowledge points for students.

Based on how little help and trust we give it, the computer mostly gets the usual patterns we need from a very big sample. Using factors that are often sent, different pieces of data can be linked together. Going through each layer one at a time was how Apriori [17] did it. The brain levels and knowledge map files of the trainers make it possible for knowledge point processes to happen. The knowledge points in the library of knowledge maps are in the set $r = \{1, k_2, \dots, \}$. They are shown in Set $s = \{c_1, c_2, \dots, c_V\}$. This is the level at which you should get a list of things that kids don't fully understand. It is less than the cutoff number, which means that students don't fully understand certain information points. The set $ng = \{n_1, n_2, \dots, nm\}$ and $0 \leq m \leq n, ny \partial kb$ show the lessons that are not learned. If a person wants to reach knowledge point N , they need to master both that point and the rule that

goes with it, which is $B \Rightarrow B$. That is, they won't be able to master the target knowledge point if they can't master knowledge point B . This is because $B \approx nb$, $B \subset nb$, or $B \subset kb$, but $D \cap B = \emptyset$. The apriori method is based on the idea that you need to find sets of items that are used a lot based on support and confidence. How likely is it that you will see one set of items when another set of items happens? Support is the percentage of the information that has the current set of items. It is called a common item set when it meets the bottom support level. A set of things must also meet a certain amount of trust before it can be used to make strong links. It is shown how to make a knowledge map with 584 knowledge points in middle school math. Table 2 shows some of the test question and answer sheets that every student on the online school page has. To pass, you need to have a thinking level of 0.9. Things in the \mathcal{K} set that are below this level are things you know but don't fully understand. The very least amount of support is $\text{minsupport}=0.53$, and the very least amount of confidence is $\text{minconfidence}=0.91$. Questions that are often asked about things that have not been learned are shown in Table 3.

Table 2: The Information That Is Not Limited

Question No.	Knowledge Points Not Mastered (ng)
EX-NO-01	2, 4, 15, 23
EX-NO-02	2, 7, 8, 10
EX-NO-03	1, 5, 9, 20, 21
EX-NO-04	19, 16, 3, 6
EX-NO-05	11, 25, 14, 17

Table 3: Set Of Information Points with A Lot of Items.

Serial No.	Itemset	Support (%)
FQ-IT-1	1, 4, 13, 17, 20	30
FQ-IT-2	1, 2, 4, 7, 19	55
FQ-IT-3	1, 4, 7, 17, 19	66
FQ-IT-4	4, 7, 8, 11, 15	12
FQ-IT-5	2, 3, 10, 21, 25	53

The set of things that student Li has most often is um . People who want to learn must be given a way to get to the information points they want to learn. This way is known as the learning process from mm to goal information S points. Two knowledge points are joined in a way that makes sense in the knowledge map. This study adds a link to the knowledge point series to make it more correct. The learner's knowledge points are put in order, and the knowledge point with the best connection is picked to move on with the search. It looks like this when you do the association calculation:

$$R_{\text{corr}}(v) = (1 - \theta) + \theta \times \sum_{u_i \in \text{in}(v)} \frac{\text{sim}_{uv} \times R_{\text{corr}}(u)}{\sum_{u_k \in \text{out}(u)}$$
(16)

The correlation coefficient is 0.9, $VcUrr(u)$ and $RcUrr(X)$ show how closely knowledge points u and X are linked, $ui \in \text{in}(X)$ shows how many edges connect u and X , $uk \in \text{out}(u)$ shows how many knowledge points (edges) are linked to u , and $\text{sim}uX$ shows how similar u and X are to each other. The math in this study is done with cosine similarity.

Design of Recommendation Algorithm

Resources are what carry information in online learning systems. The learning path this paper looks into is made up of both knowledge points and resources. The association rule algorithm was used to get the learners' learning order (the order of the knowledge points). In this part, the group intelligence algorithm is mostly used to match learning tools for each knowledge point based on the learners' learning order. This study also looks at the learners' personalities so that the suggested learning path can be different for each person.

Degree of Matching

You can find out which of the many learning tools are most relevant to your current knowledge points by looking at how well they match up with those points. In this study, the level of matching is measured by how well learning resources cover things that have already been learned and how closely present knowledge points are linked to those resources. This is done so that kids can learn better. To figure out the degree to which knowledge points and materials were matched for this work, do it this way:

$$M_r = \left| \frac{m_j}{s} - \sigma \right| \times \frac{cou_i}{\sum_{k=1}^{m_j} cou_{jk}} \quad (17)$$

There are four parts to this equation: The number M shows how many knowledge points resource j looks at. The number O shows how many knowledge points learners have mastered. The value \square shows how well the resource covers the knowledge points that learners have mastered. Its number stays the same from 0 to 1. In an ideal world, the lessons would teach the children everything they need to know. This time, \square equals 1. It tells you how many times knowledge point i appears in resource j and how many times all knowledge points appear in resource j .

Learners and resources that can be changed

“What does “fitness of learners and resources” mean? It means whether the resources are right for the students' school level. Different from other types of ideas, personalized tips can help each student in an online school find the best tools for learning. It is possible to make specific advice based on the traits of students used in this study to measure health. As shown in the learner model made for this study, learning ability, learning style, and learning effort are the most important learner traits used to measure health. If the recommended resources are too easy for the learners, the learning ability check will be negative. If the recommended resources are too hard for the learners, the learning style check will be positive. And if the recommended resources take too long to learn, the learning intensity check will be negative. So, this is the exact measure of how healthy the students and supplies are:

$$G_f = \lambda C_i \times \frac{1}{1 + e^{-(|L_i - H_j|)(|S_i - D_j|)}} \quad (18)$$

which tells us how well the learner and resource are matched, what kind of learning style the learner has, and what the control parameter is. In this case, $\square = tij/ti$ is the ratio of the type of resource to the type of learning style. Here, ti is the type of resource that students with learning style Li should be paired with. The main ways to learn in this paper are through writing, video, pictures, links, movements, and tables. This resource is of type $t \square j$. As long as $n=1$, resource j is good for learner i . It's not good for learner i if $\square=0$. These things have to do with how tough you are being to learn. The junior high school math knowledge base tells us Nj (how long it takes to learn the information), Si (how well it can be learned), and Dj (how hard it is to learn). In short, the idea of giving each person a personalized learning path is

$$F = \omega_1 M_r + \omega_2 G_f \tag{19}$$

where F is the objective function, ω_1 and ω_2 are the weights, and M_r and G_f are the fitness and matching degree, respectively.

4. Planning An Experiment

4.1 Details About The System

It was found that the services mentioned in this study worked with the learning tool Moodle. As was said at the beginning, Moodle is an open-source learning tool that lets anyone use PHP to create add-ons and function modules that work with Moodle. It was meant to be easy for students and teachers to use by adding the useful block. In this case, Table 4 shows that Linux was used as the operating system base. For the basic needs setting, a user had to build a full LAMP base before running Moodle. You can find the open-source PHP, Perl, Python, and other computer languages on a LAMP platform. It also has the Linux operating system and an Apache web server.

Table 4: The Setting for The System Surroundings.

Hardware	
CPU	Intel Core i7 7700K 4.20GHz
Memory	32GB
Hard Disk	1TB
Monitor	PHILIPS 328C7QJS
System support	Original technical support
Software	
Operating system	Ubuntu 18.04 LTS
Server	phpStudy 2018 + Apache 2.4.23 + PHP 7.0.12
Programing	Visual Studio Code
Database	MySQL5.5.53
Database management tool	phpMyAdmin 3.5.8.2
E-learning platform	Moodle3.6.2

4.2 Experiment Procedure

What was learned in real life was "programming" at Technology University in the middle of Taiwan. It used both the suggested service and the Moodle e-learning management platform to look at what students knew before and after they used the recommended platform. This is how the test went, as shown in Figure 5:

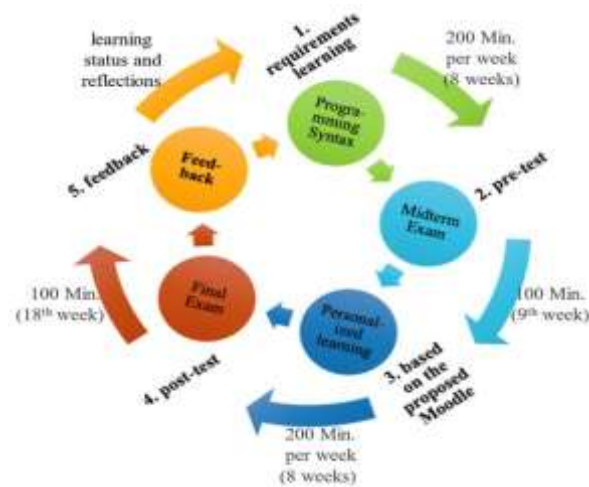


Figure 5: How To Do the Experiments at The Practice Course.

Step 1. Learning the requirements for programming: In a school setting, a teacher taught programming terminology to provide basic training in programming. Students learned and understood computer language better with the help of extra code examples.

Step 2. The review test included both a reading test and a computer test to see how much the students had learned in the first eight weeks. This was done so that the next step in their specialized learning could be planned.

Step 3. customized Learning: The midterm results showed that students learned on their own on the Moodle e-learning platform with the study's tailored service. It let students change or improve what they were learning based on how they did on the test.

Step 4. Final test: After 18 weeks, there was a final test to see how well the project went.

Step 5. Feedback: The learning feedback service was used to find out what was thought about and how much was learned.

4.3 Results

Table 5 shows the scores from the test before and after it. The mean score on the post-test was 74.67, higher than the mean score on the pre-test, which was 71.49. The worst and best scores on the post-test were both better than the pre-test results. Table 6 shows that the mean of the post-test was higher than the mean of the pre-test. Standard deviation was also less on the test after the change than it was before the change. Here, "small" means that the post-test results didn't change a lot from the first test. After the learning, there was less of a gap between students on the post-test than there was on the pre-test. However, Table 5 ($p = 0.191 > 0.05$) shows that the matching t-test values were not very different from each other. Two types of tests were on the computer test, so that could be one reason. But the personalized tool that was offered made the intellectual part better, but it didn't give the kids any computer practice. The mean score on the test after using the suggested platform was higher than the mean score on the test before using the suggested platform. Table 7 showing Paired T-Tests To See If There Is A Change Between The Pretest And Post-Test Mean Scores.

Table 5: What The Range of Scores Were for The First Test and The Second Test.

The Rang of the Score (Acronyms S)	The Number of Students			
	Pre-Test		Post-Test	
	Count	Accumulation	Count	Accumulation
$S < 30$	7	7	0	0
$30 \leq S < 40$	1	8	0	0
$40 \leq S < 50$	4	12	7	7
$50 \leq S < 60$	0	12	5	12
$60 \leq S < 70$	3	15	4	16
$70 \leq S < 80$	1	16	10	26
$80 \leq S < 90$	6	22	3	29
$90 \leq S < 100$	19	41	4	33
$S = 100$	0	41	6	41
Total number of students		41		41
Lowest score		20		43
Highest score		96		100

Table 6: The Math That Was Used to Compare the Pre-Test and Post-Test Scores.

Comparison	Means	The Number of Sample	Standard Deviation	Standard Error of the Mean
pre-test	71.49	41	27.56	4.304
post-test	74.44	41	20.15	3.147

Table 7: Paired T-Tests to See If There Is a Change Between the Pretest and Post-Test Mean Scores.

Comparison	Paired Difference					Degree of Freedom	p-Value	
	Means	Standard Deviation	Standard Error of the Mean	95% Confidence Interval				T
				Lower	Upper			
pre-test post-test	-2.951	14.216	2.22	-7.438	1.1536	-1.329	40	0.191

5. Conclusions

The fast growth of online education has given students access to more high-quality learning materials, but it has also caused students to forget what they already knew. Because of this, it is important to give each student personalized learning support. This study suggests a customizable learning path suggestion model that uses more than one method to work together. The apriori method is first used to turn the junior high school math knowledge map into a list of knowledge points for students. Then, this list of knowledge points is used to decide the way in which the learners will learn, taking into account their cognitive level, learning style, and how quickly they learn. This lets the algorithm suggest a personalized learning path. Last but not least, tests are used to show that the model works. The test scores show that students who followed the suggested path to learning did much better on the linked subjects than students who didn't follow the suggested path to learning. The results of their learning also changed a lot. This helps students understand what they are learning better and do better in school by making learning more focused and useful. There are also different points of view on the methods used in the model in this article. The PSO algorithm is better at handling the path selection problem than other algorithms in terms of how stable it is and how quickly it converges. The quality of the learning path is pretty good when it works with the backwards method to suggest.

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