

High School Students Differentiated teaching on self-directed learning guidance

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Abstract: Self-directed learning (SDL) capacity is one of the core common values of students, as defined in the Vietnam General Education Curriculum 2018 (VGEC). Because of the students' variety in capacity and needs, educators are challenged to assist in the development of self-directed learning skills and to encourage learners to more freely use self-direction in their learning activities by personalization and differentiation in teaching practices. However, previous works on SDL in Informatics for Vietnamese students mainly focus on educators' teaching without considering academic diversity. Our work introduces differentiated teaching and criteria to classify students in Informatics. On the basis of criteria, we designed a procedure to develop SDL capacity in Informatics for high school students. We applied our method and examined the results by assess the perceptions of self-directed learning on 147 students from 5 provinces nationwide. The SDL capacity assessment shows that our differentiated teaching method provides an improvement on students' SDL capacity scores, particularly the male students and the students living in rural areas.

Keywords: Differentiated teaching, Informatics teaching, self-directed learning capacity.

1. Introduction

Differentiated teaching, which was first introduced in the work of Tomlinson (1999), is a key high-impact teaching strategy used by teachers to craft lessons that provide the right amount of support and challenge to every student. It is widely applied to a wide range of fields in education, to provide high-quality, evidence-based instruction that meets all students' needs depending on their starting level and what they are expected to learn in that lesson. On the other hand, in VGEC, Informatics teaching plays a key role to develop the skills and abilities to seek, select, receive, and expand knowledge sources, not only in Informatics but also in other subjects. Our work introduces a differentiated teaching paradigm applied in Informatics teaching for high school students to develop their SDL capacity and readiness.

Differentiated teaching is a fundamental pedagogy including constructive instructions adapted to what students already know. It is fundamental in inclusive education where students have different academics situations, circumstances, different skills and learning needs (Gregory & Chapman, 2002; Heacox, 2002; Soldengeld & Schultz, 2008; Tomlinson, 1999, 2000, 2001). In a regular classroom setting with differentiated teaching, students attain their own results by appropriate guidance and being responsible for the knowledge they gain (Craib, 2011).

Differentiated instruction is a mandatory tool to reach important goals of general education declared in VGEC, which is to help learners to be more responsible in their learning, to have benefited from their knowledge and to maintain the self-directed learning ability not only in professional work but also their personal lives. However, in traditional teaching methods where teachers appeared to be more concentrate on maintaining routine in large classrooms than matching instruction to individual differences, have poor performance in SDL capacity and academical achievement (Zigmond, 1990, Scott, 2002).

As stated in General Education Program in Informatics (VGEC, 2018), developing students' SDL readiness and capacity is a key goal to meet the changing demands in education. However, it is shown by Kamran (Muhammad Kamran, 2019) that conventional teaching methods in Vietnamese education standard results in deficiencies and students' failure to reach their own goals. This finding is also supported in the work of Thuy (Thuy, 2011), Tao (Tao, 2019) and Tuyen (Tuyen, 2007). On the other hand, multiple works have focused on the application of differentiated teaching methods for Vietnamese situations and cultures. Example includes work of Hung (Hung, 2008) and Lam (Lam, 2020).

Although differentiated teaching methods are researched widely and apply to limited subjects in high school, researchers only focus on the diversity of learners in traditional classroom settings. Little attention has been paid to guidance for students in learning outside classrooms taking into account the wide gap between academically

advanced and less academically advanced groups. As consequence, students have low performance and results in low SDL capacity and readiness, particularly students in mountainous areas (Thuy et al., 2021). Moreover, the poor performance of differentiated teaching is due to the lack of criteria to bring different avenues to the learners to gain the content of the given course, thereby adapting to meet the wide gap of student requirements.

In this paper, we propose the process of guiding students to self-study on the basis of classification criteria to divide differentiating learners, which is in need after the goals of general education in Informatics have been identified in VGEC (VGEC). The main contributions of this paper are as in the following:

- Propose a new procedure applying differentiated teaching to develop SDL capacity of students in Informatics.
- Use an SDL scale to survey and analyse the SDL capacity of 147 school students from 5 provinces nationwide to estimate the effect of our procedure on Informatics learning.

The rest of the paper is organized as follows. After introducing a state-of-the-art differentiated teaching method in the literature Section 2, we present our procedure which includes 3 steps to develop students' SDL capacity on Informatics in Section 3. In Section 4, we describe our implementation on 147 students in an Informatics course to improve their SDL capacity and provide the analysis of the results. Finally, we conclude this paper in Section 5.

2. Literature Review

2.1. Differentiated teaching

According to Tomlinson (2000) differentiated teaching is not a strategy but the way in which we think of our learners, teaching and the learning process. In order to define and differentiate one's own teaching correctly, it is the responsibility of the teacher to get to know his or her learners (Manning, Stanford & Reeves, 2010). Differentiated teaching is therefore responsive teaching rather than 'one size fits all teaching', consequently starting where the learners are and reaching the capacity of each learner by bridging the gaps in understanding (Cox, 2008). Through this way of teaching teachers start to know their learners by changing the classroom environment, to see their learners' capacity levels, learning preferences and interests, and needs more clearly (Cox, 2008). This can be done by grouping learners accordingly and organizing teaching around a flexible content, process and product (Levy, 2008). Content refers to what we teach and a learner learns and is differentiated by interest; process refers to the way we teach and the activities a learner engages in while learning, and is differentiated by capacity; and product refers to the activities completed during lessons which demonstrate how learning has occurred, and is differentiated by learning preferences (Cox, 2008; Levy, 2008; Ellis, Gable, Gregg & Rock, 2008, in Manning et al., 2010). With the tools of differentiated teaching, we can keep the focus on teaching all the learners equitably and take each learner as far as he or she can go on their educational path (Levy, 2008) which will result in the teacher's "growth towards professional expertise" (Tomlinson, 2000, p.31). Differentiation is therefore doing "whatever it takes to ensure that struggling and advanced learners, students with varied cultural heritages, and children with different background experiences all grow as much as they possibly can each day, each week, and throughout the year" (Tomlinson, 1999b, p.2).

2.2. Criteria to differentiate students in the learning process

To divide learners into groups with different features, one needs to take into account criteria to identify goals, needs and tasks of each individual. In this section, we review 5 main factors that educators use to classify students in differentiated teaching.

Cognitive capacity

Bloom's taxonomy was first introduced in 1956 as a hierarchical framework for classifying students in the cognitive domain (Bloom et al. 1956). The framework was first used to exchange test items among faculty at various universities to create sets of items, each accessing one educational objective. The original Taxonomy includes definitions of six main categories in the cognitive domain: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. With the exception of Application, each of these was broken into subcategories.

On the basis of the original Bloom's taxonomy, multiple approaches are introduced to apply the framework in high school education. Anderson et al. (2001) presented a revised version that includes more useful and comprehensive additions of how the taxonomy intersects and acts upon different types and levels of knowledge, i.e. factual, conceptual, procedural and metacognitive. Also, the taxonomy is widely used to assess students' learning and educators' teaching method. Moreover, one can use the taxonomy to assess and differentiate students based on their cognitive and metacognitive capacity.

Psychological personality

Psychological personality is one of the important factors that educators use to provide differentiated instructions to students in classrooms. Carl Jung introduced the concept of psychological types in one of his most famous and important works, the book *Psychological Types* (C. G. Jung, 1971). It was later revisited and further developed by Katherine Briggs and her daughter Isabel Myers into a practical self-report assessment tool called the Myers–Briggs Type Indicator (MBTI) (Myers, 1987). By using their tool to measure one's psychological types, an individual receives a group of four letters, which indicate their preferences for each dimension: Introvert (I) or Extravert (E), Sensing (S) or Intuition (N), Thinking (T) or Feeling (F), and Judging (J) or Perceiving (P).

On the other hand, to understand the connection between learners' personality and their academic behaviors, the Big-Five personality framework (Salgado Jesus, 1997), a hierarchical model of personality traits with five broad factors, has become the most widely used and extensively researched model in the literature. It represents personality at the broadest level of abstraction. Each bipolar factor in its dimension (e.g., Sensing vs. Intuition) outlines several more particular facets/characters (e.g., Sociability). These facets then classify a huge number of more specific traits.

Using psychological personality assessments brings important factors to educators whose responsibility is to classify class into groups and provide appropriate differentiated instructions to each group. Moreover, these assessments determine if the personality types or any of the major traits significantly contributed to the effectiveness of teaching methods (DJ Teachout, 2001).

Type of learner

Performance of learners is different in learning activities despite the same instructions provided by the same teacher, with the same teaching method (Razavi, 2014; Reid, 1998). Types of learners, which are identified by their preference, play a vital role in the learning process (Mackey, Gass, & McDonough, 2000). It is also stated in works of Lee et al. (Lee & Kim, 2014) and the work of Rubin (Rubin, 2011) that different types of learners perform differently while they are engaged in various learning situations.

First introduced by Kolb in 1984 (Kolb, 1984), the concept of learning style has enjoyed considerable support and has become the most widely used and extensively researched tools to improve teaching and learning quality in higher education. Kolb also (Kolb et al., 2001) introduced a four-stage cycle of learning: Concrete experience, reflective observation, abstract conceptualization and active experimentation. On the basis of the four-stage learning cycle, Kolb's learning theory specified four distinct learning styles: Diverging, assimilating, converging, and accommodating. On the other hand, Reid (1995) has divided students' learning styles into three major categories: cognitive, sensory, and personality. Each of these is further classified into different subcategories. For instance, sensory style is comprised of perceptual or environmental style. In particular, perceptual learning style associated with four types of students: auditory, visual, tactile, and kinaesthetic learners.

Addressing a students' learning style during academic lessons will most likely improve their academical achievement. Even if the final assessment of the lessons is not a match for the learner's preferences, the performance of students is significantly improved in comparison to the result of traditional teaching methods where learning styles of each student is not recognized (Tomlinson et al., 2003). By the identification of their lesser preferred learning styles, teachers should provide instructions and activities designed in ways that offer each individual opportunity to learn effectively. Moreover, learning plans and provisions that are typically available to learners are evaluated and developed to be more appropriate learning opportunities. However, little attention has been paid to the relationship between SDL capacity and different learning styles.

Cognitive style

In 1948, Asch and Witkin (Asch et al., 1948) introduced an apparatus called the Rod and Frame Test and Embedded Figures Test to classify participants into field-dependent or field-independent. Field-independent is a cognitive style in which the person consistently relies more on internal referents (bodily sensation cues) than on external referents (environmental cues). In contrast, field-dependent cognitive style is defined by a relative inability to distinguish detail from other information around it.

It is shown a strong relationship between learners' SDL capacity and their cognitive styles. Students with independent cognitive style often have the ability to be independent and autonomous in exploring and discovering knowledge, but introspective, paying little attention to the surroundings. On the contrary, students with dependent cognitive style need attention and help of others in their learning process, extrovert and have the ability to socialize. For this reason, successful self-directed learners exhibit characteristics close to those of the field-dependent cognitive style in a number of significant ways.

Intellectual ability

In traditional psychometric views on intelligence, people have only one single type of intelligence which is mainly exposed in cognitive abilities. In the book *Frames of Mind: The Theory of Multiple Intelligences*, Gardner (Gardner, 1983) first introduced his theory that challenged the traditional notion by broadening the definition of intelligence. In particular, he suggested that people have 8 different kinds of "intelligences": Linguistic, Logical/Mathematical, Spatial, Bodily-Kinesthetic, Musical, Interpersonal, Intrapersonal, and Naturalist. While a student might be particularly strong in a specific area, he or she most likely have multiple capacities. For instance, an individual might be strong in verbal, musical, and naturalistic intelligence. Gardner also stated that the linguistic and logical-mathematical modalities are most important for students to learn in school and society.

On the other hand, psychologist Robert J. Sternberg has proposed the triarchic theory of intelligence which is originated as an alternative to the concept of traditional general intelligence theory (Sternberg, 1985). In his theory, intelligence ability is divided into 3 types: practical (the ability to adapt to different situations), creative (the ability to create new ideas), and analytical (the ability to analyze information and solve problems). He also stated that intelligence isn't fixed, but rather comprises a set of abilities that can be developed.

For differentiated teaching methods in Vietnam, educators only focus on intellectual ability which is provided in academic report cards. Overlooking psychological and cognitive factors leads to poor performance of differentiated teaching in high school in Vietnam. Our research utilizes 5 factors mentioned above and guides students to self-identify their own goals, tasks, resource and strategy in learning Informatics, which leads to significant improvement in students' SDL readiness and capacity.

2.3. Self-directed learning capacity

Self-directed learning has emerged and literally exploded around the world in the last few decades under the realms of academic research and education. The definition of SDL was first introduced in the original work of Knowles (Knowles, 1975). Knowles considers self-directed learners as proactive students who take the initiative in their learning, actively control and influence their learning processes. The SDL capacity includes 4 factors as in the following:

- Ability to recognize the need of learning: have the motivation to learn and desire to step into learning processes.
- Ability to identify goals of learning: identify the external goals and internal goals. For example, response to teachers' requests is an external goal while satisfying learners' own needs and interests is an internal goal.
- Ability to identify learning tasks: the ability to identify how much time should be used for each task; complete the assigned work before doing the extra work; understand the lesson in class before trying to discover more on their own; find out what's relevant or extended from the lesson. Moreover, it is also the ability to seriously implement assigned learning tasks: prioritize completing all assigned assignments before doing other things; do the exercises carefully and check the results.
- Ability to identify learning resources: Learners have to search, evaluate and choose appropriate sources of materials for different learning purposes and tasks. Moreover, they need to recognize, adapt and take advantage of learning conditions and circumstances.
- Ability to identify learning strategies. This ability expresses in several behaviors as follow:
 - Form learners' own learning method.
 - Record/write information in suitable forms that are convenient for memorizing, using, and supplementing when necessary.
 - Make necessary decisions to meet learning needs.
 - Change the direction of learning in certain conditions.
 - Self-actualization and self-seeking opportunities to develop and fulfill one's potential.
 - Evaluate and adjust the study plan.
 - Self-recognize mistakes and limitations in the learning process (including assessment).
- Know how to reflect on learning processes, learn from experience then it can be applied to other situations, know how to self-correct learning method (including assessment). Ability to self-evaluate: Self-assess the learning process, it includes: (1) Identify how the learning is going: determine the current

learning method, the knowledge concentrated, determine the appropriate goals are set or not and (2) identify what needs to be improved from learning methods, knowledge understanding, goals, study schedule and daily activities. For example: What parts of my knowledge and skills are still unclear or are needed to learn more? Which parts of the lesson should be explored and discovered more; Is time for learning and for daily activities set appropriately?

Improving the learners' SDL capacity is defined as one of the most important roles of the general education program in Vietnam (VEGC, 2018). In the next section, we describe our proposed procedure to apply differentiated teaching to improve SDL capacity for students in Informatics.

3. The proposed process of guiding students to self-study based on differentiating criteria

In this session, we present our proposed process for educators to guide students to develop their SDL capacity and capacity on the basis of differentiating criteria. The process includes four steps as in the following:

- Step 1: Identify and classify students according to differentiation criteria
- Step 2: Develop a plan to guide students in self-study in the direction of differentiation
- Step 3: Implement the plan, evaluate the SDL capacity and make adjustments

We describe each step in the following.

3.1. Identify and classify students according to differentiation criteria

The most important step before providing appropriate instructions to each learner is to identify their academical features, what they want and need. In this paper, the use of the combination of 5 differentiated factors helps us to overcome the weakness of the differentiated teaching application in Vietnam, where students' academical report cards are the only source to differentiate them into groups.

Table 1. Tools to classify students by differentiation criteria

Criteria	Type	Tools
Intellectual ability	Students only stop at the level of knowledge	Academic report card, academic record, knowledge test at the beginning of the school year. It is prepared and stored carefully at high schools in Vietnam.
	Students understand the knowledge	
	Students apply knowledge in life.	
	Students evaluate, analyze and create based on existing knowledge	
Psychological personality	16 types	Academic records with comments from junior teachers and psychological tests: http://www.humanmetrics.com/personality
Learner types	Diverging	Observation table of the behavior of students
	Assimilating	
	Converging	
	Accommodating	
Cognitive style	Independent	Observation table of the behavior of students
	Dependent	
Intellectual ability	Analyze	The first test of the school year with different types of questions and tests: https://www.idrlabs.com/multiple-intelligences/test.php
	Creative or synthetic intelligence	
	Practical intelligence	

In order to guide students to self-study in the direction of differentiation, teachers need to be able to classify students' objects. Most high school students have revealed their personal elements from previous grades. Teachers

can track students' academic records, use initial assessments or psychological tests to get accurate information about each group of students. Table 1 below is a suggestion of tools for teachers to classify students according to the criteria presented above.

3.2. Develop a plan to guide students to self-study in the direction of differentiation

On the basis of the classification, educators develop a plan helping students to be self-reliant in their learning process. The results of the plan are to identify their self-study needs, determine their learning goals, learning resources, learning strategies and evaluate learning outcomes.

Identify learning needs

Teachers guide students to identify their own learning needs and motivations on the basis of their classification group. For example, learning needs of students with extroverted personality are mainly to impress other people such as their parents, teachers, or friends. In contrast, learning needs of students with an introverted personality is to experience and enjoy their own learning process. Similarly, for students with average cognitive ability, their learning needs are simply to perceive the knowledge provided by the teacher, while students with higher cognitive ability have higher learning needs such as exploring and discovering new knowledge to enrich their existing knowledge.

Identify learning goals

Learning goals can be divided into external objectives and internal objectives. Another classification of learning goals is goals in short, medium and long term. On the basis of the classification, educators help them to determine appropriate goals for each category. For example, the goal for average students is only to do all the exercises in the textbook and the exercises assigned by the teacher; students with good cognitive ability can set goals to do advanced exercises, exercises in reference books, and self-made exercises. Divergent or assimilated learners only aim to understand the knowledge provided, while convergent and adaptive learners have the goal of applying that knowledge to problem solving in real life. Students with dependent learning styles always need the guidance of teachers or parents and relatives to complete their learning goals; and students with independent learning style, the goal is to own knowledge, form skills and abilities for themselves.

Identify learning resources

To identify learning resources, students analyze knowledge and skills they can attain from different learning resources; exploit the learning media that is most suitable for them. For example, in the subject Algorithms, students with dependent learning styles will only use learning resources provided by teachers such as textbooks, exercise books, and video lectures. In contrast, students with independent learning styles actively search for resources on the Internet, which can be videos that teach advanced skills or use another graphic software with more advanced features.

Define a learning strategy

Learning strategy is greatly influenced by the individual traits of each learner. To define a strategy for each student's learning process, one determines learning methods and make a plan for the whole learning process. For students with good cognitive ability, they often have their own learning methods and make a study plan suitable for themselves. In contrast, the students with average cognitive ability needs assistance in determining which learning methods are appropriate, as well as how to plan their learning. For students with practical intelligence type, their learning methods need to be associated with physical activities, such as walking while studying and memorizing. Moreover, students with creative intelligence type need to associate lesson content with works of art or map, visualized, and musicalized knowledge. Students with analytical intelligence may simply write the content of the lesson in their notebooks and read it aloud to memorize and understand. On the other hand, for students with extroverted personalities, a feasible learning strategy is to create competition and emulation with other students. In contrast, teachers can direct students with introverted personality into the learning strategy of achieving each level in the student's own process.

Similar to learning strategy, making a study plan and a timetable for studying is highly depended on individual traits and the goals they determined in the previous steps. For example, introvert students want to increase their time studying at home while extrovert learners only use effectively time study in class.

Assess learning outcomes

Students assess their learning outcomes based on the goals identified, evaluate their learning methods and evaluate the shortcomings that need to be improved.

3.3. Implement the plan, evaluate result and adjust

After having plans to guide students in self-study, teachers can support them in each component capacity, assign learning tasks for students to learn on their own, and encourage them to learn on their own. The table below is the criteria and their manifestation we use in teaching the module Graphic Software, of the Informatics program grade 11th.

Table 2. Criteria to estimate the SDL capacity of student on Graphic Software teaching

Criteria	Manifestation in the module Graphic Software
Identify learning goals	Identify the right learning goals: <ul style="list-style-type: none"> • Ability to use some basic functions of graphic design software. • Create simple, useful and practical digital products such as logo, banner, advertising topics, posters, greeting cards, etc. • Define goals that are suitable for each student, such as: creating digital products according to the student's needs, the product possesses the own technical and aesthetic creativity; digital products are associated with a real-life event that they are responsible to design and implement; or products must have high aesthetics and their own identity. • For the selected topic, define clear and detailed goals. For example: how detailed should the product be, what knowledge and skills should be applied in the process.
Identify learning task	<ul style="list-style-type: none"> • Identify the right learning task: • Practice the tasks and exercises given by the teacher in the classroom. • Learn to manipulate different graphic design software • Expanding knowledge through additional readings, searching for more documents on the Internet. • Identify learning tasks based on achieved results.
Identify learning resources	<ul style="list-style-type: none"> • Use the right working process to work with computers and graphic design software • Use the search engine to find information for the requested graphic product. • Select the information suitable for the project • Exploiting open learning resources to gain more knowledge about word processing. • Share projects with teachers and other groups through digital tools such as Padlet, Google Drive, etc. • Depending on specific circumstances, the project can be carried out at school or at home.
Identify learning strategy	<ul style="list-style-type: none"> • Set a timetable for each exercise and task. Have a clear plan on the resources and tools to use (guidance from teachers, books, classmates and resources on the Internet) • Record knowledge gained. • Observe and learn from students' own work and comments from teachers and class members. • Evaluate and adjust the learning plan after finishing each lesson and task given by the teacher.
Assessment	Using assessment support tools such as checklists, rubrics to assess the learning process: <ul style="list-style-type: none"> • Did the learning go as planned? • What are the current learning methods and tools being used? • What knowledge is being concentrated? • Evaluate the level of completion. Find some factors of the learning process needed to be improve, set a plan to improve them. Assess learning outcomes by: <ul style="list-style-type: none"> • How much knowledge related to graphic design software • What knowledge has been applied to complete the tasks? • What knowledge is known but not yet used?

4. Evaluation the method

To estimate the effect of our proposed strategy to improve SDL capacity of learners in Informatics, we implement the 3 steps to teach the subject Graphic Software on 77 students. The process is within 3 months. We

also teach the subject in normal class setting and traditional teaching method for another group of 70 students. The SDL instrument proposed by Thuy et al. (Thuy et al., 2021) is used to estimate the advantage of our proposed method in comparison with traditional teaching method in term of SDL capacity. Table 3 show the SDL capacity of student before the process.

Table 3. SDL capacity scores after using our proposed strategy.

		SDL capacity score increment			
		2.00	3.00	4.00	5.00
Time for self-studying	More than 2 hours a day	-53.85%	-37.50%	60.00%	100.00%
	Less than 2 hours a day	-18.75%	-30.77%	45.45%	100.00%
Gender	Male	-45.45%	-33.33%	54.55%	133.33%
	Female	-27.78%	-33.33%	50.00%	66.67%
Area of residence	Municipality	-23.08%	-50.00%	41.67%	100.00%
	Rural area	-43.75%	-11.11%	66.67%	100.00%

For traditional teaching method, the SDL capacity scores are shown in Table 4 below.

Table 4. SDL capacity scores after using traditional teaching method.

		SDL capacity score increment			
		2.00	3.00	4.00	5.00
Time for self-studying	More than 2 hours a day	-20.00%	-16.67%	22.22%	40.00%
	Less than 2 hours a day	-18.18%	-10.00%	18.18%	33.33%
Gender	Male	-20.00%	-12.50%	20.00%	66.67%
	Female	-18.18%	-12.50%	20.00%	20.00%
Area of residence	Municipality	-12.50%	-10.00%	25.00%	25.00%
	Rural area	-30.00%	-16.67%	16.67%	50.00%

As can be seen in the Table 3, the SDL capacity of students using more than 2 hours a day for self-studying has significantly increased after the course using our proposed strategy. The same phenomenon is observed in the group of students spending less than 2 hours self-studying a day. For example, after the course, for students using more than 2 hours for daily self-studying, the portion of SDL score levels 4 and 5 increase 60.00% and 100.00%, respectively. Similarly, for students with less than 2 hours of daily self-studying, the increment in levels 4 and 5 are 45.45 % and 100.00%, respectively, while the portion of students remaining in level 2 significantly decreased by 18.75%. On the other hand, as shown in Table 4, there is only a slight increase of SDL score in less-than-2-hour-self-studying students and students living in municipality areas when using the traditional teaching method. In contrast, with our teaching method, the average score of municipal students and students living in rural areas increases by 12.31% and 16.19%, respectively. This demonstrates the effect of our strategy on SDL capacity of students in all groups.

Special statistics was observed in groups of students living in municipality area and rural area. After using our strategy to improve SDL capacity, the average SDL score of students in rural areas increase from to 2.9 to 3.4. Furthermore, average score of students in municipality slightly increase from 3.2 to 3.6. In comparison with the traditional teaching method shown in Table 4, the SDL scores attained by our method has significant increment. The reason is the students in municipality have been taught in modern environment with new teaching technique. As a consequence, they have been more active in learning and acquiring knowledge than rural students before our course. In contrast, students in rural area are experience traditional teaching methods, where teachers take the main roles in class, they are usually passive in their class. Also, they often have fewer educational opportunities than municipal students. Hence, our method distributed a greater impact on SDL capacity of students in rural area than students living in municipality.

It is worth noting that our method has more impact on male students than female students. In particular, the increments in male and female student are 15.08% and 12.84%, respectively. A part of the reason may be because the gender differences in interest, male students prefer to work with things while female students tend to work with people. Hence, male students have a slight advantage over female students, particularly when use their SDL skills to work with computers.

Finally, we found that the students benefitted from the application of differentiated learning principles in many ways. For example, in comparison the previous semesters, the students were generally much more engaged to the subject and more active to apply their skills to the real life. Thus, our findings demonstrate the advantage of differentiated teaching in Informatics to improve students' SDL capacity, challenging the prevailing assumption that traditional teaching methods are the best fit for Vietnamese student.

5. Conclusion

For high performance in Informatics teaching, an appropriate differentiated teaching must be applied Vietnamese students with differences situations and circumstances, as mentioned in VGEC. This paper addresses criteria to classify students into group on the basis of their cognitive capacity, psychological personality, type of learner, cognitive style and intellectual ability. We introduce a novel procedure which guide students develop their SDL capacity in Informatics within 3 steps.

We implement our teaching method on Informatics teaching with 147 students from 5 provinces in Vietnam. The analysis of SDL scores before and after our implementation shows that our teaching method helps students significantly improve their SDL capacity. The results also shows that the method has huge influents in students in rural areas who study only in traditional large classroom settings with the traditional teaching methods.

Reference

- Anderson, L. W. and Krathwohl, D. R., et al (Eds..) (2001) *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. Allyn & Bacon. Boston, MA (Pearson Education Group)
- A Abdollahi, B Vadivel, DTN Huy, MJC Oplencia, P Van Tuan. (2022). [Psychometric Assessment of the Persian Translation of the Interpersonal Mindfulness Scale With Undergraduate Students](#), *Frontiers in Psychiatry*, 632
- Asch, S. E., & Witkin, H. A. (1948). Studies in space orientation: I. Perception of the upright with displaced visual fields. *Journal of Experimental Psychology*, 38(3), 325–337. <https://doi.org/10.1037/h0057855>
- Baker, J.M., & Zigmond, N. (1990). Are regular education classes equipped to accommodate students with learning disabilities? *Exceptional Children*, 56, 515-526
- Bloom, B., Englehart, M. Furst, E., Hill, W., & Krathwohl, D. (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook I: Cognitive domain*. New York, Toronto: Longmans, Green.
- C. G. Jung, *Psychological Types*, (H. G. Baynes, trans., revised R. F. C. Hull) Volume 6 of *The Collected Works of C. G. Jung*, Princeton, NJ: Princeton University Press (1971).
- Cox, S.G. (2008). Differentiated instruction in the elementary classroom. *Education Digest: Essential Readings Condensed for Quick Review*, 73(9), 52-54.
- Craib, I. (2011). *Classical social theory*, Translated by M. Tziantzi & P. Lekka, Athens: Ellinika Grammata.
- D Thi Ngu, DT Huong, DTN Huy, PT Thanh, ES Dongul. (2021). Language teaching application to English students at master's grade levels on history and macroeconomic-banking management courses in universities and colleges, *Journal of Language and Linguistic Studies* 17 (3), [1457]-1468
- Do Thu Huong, Dinh Tran Ngoc Huy, Nguyen Thi Hang ,Pham Thi Huyen Trang ,DuongThi Ngu. (2021). Discussion on Case Teaching Method in a Risk Management CaseStudy with Econometric Model at Vietnam Listed Banks –Issues Of EconomicEducation for Students, *Review of International Geographical Education*, 11(5).
- DT Tinh, NT Thuy, DT Ngoc Huy. (2021). [Doing Business Research and Teaching Methodology for Undergraduate, Postgraduate and Doctoral Students-Case in Various Markets Including Vietnam](#), *Elementary education Online* 20 (1)
- DTN Huy. (2021). Banking sustainability for economic growth and socio-economic development–case in Vietnam, *Turkish Journal of Computer and Mathematics Education (TURCOMAT)* 12 (2)
- DTN Huy, TH Le, TD Thang, NT Hoa, LT Hue. (2021). [Discussion on E-learning solutions for students–and issues of technology application in classroom](#), *Design Engineering*, 11432-11443
- DVT Thuy, DTN Huy, VTK Anh, NN Thach, HT Hanh. (2021). [Quality of education of ethnic minority communities in vietnam-problems and recommendations](#), *Elementary education Online* 20 (4)
- Ellis, E., Gable, R. A., Gregg, M., & Rock, M. L. (2008). REACH: A framework for differentiating classroom instruction. *Preventing School Failure*, 52(2), 31–47.

- Gregory, G. H. & Chapman, C. (2002). *Differentiated instructional strategies: One size doesn't fit all*. Thousand Oaks, CA: Corwin Press.
- G Shen, J Manafian, DTN Huy, KS Nisar, M Abotaleb, ND Trung. (2022). [Abundant soliton wave solutions and the linear superposition principle for generalized \(3+ 1\)-D nonlinear wave equation in liquid with gas bubbles by bilinear analysis](#), *Results in Physics* 32, 105066
- Heacox, D. (2002). *Differentiating instruction in the regular classroom: How to reach and teach all learners, grades 3-12*. Minneapolis: Free Spirit Publishing.
- H. Gardner (1983), *Frames of mind: the theory of multiple intelligences*, New York: Basic Books, 1983.
- Sternberg, R. J. (1985). *Beyond IQ: A triarchic theory of human intelligence*. New York: Cambridge University Press.
- Hieu, L.T., Huong, D.T., Huy, D.T.N., Dung, N.T.P., & Trung, N.D. (2021). [Identifying learners' behavior from videos affects teaching methods of lecturers in Universities](#). *Design Engineering*, 11146-11157. Retrieved from <http://www.thedesignengineering.com/index.php/DE/article/view/4117>
- Hac, L.D., Huy, D.T.N., Thach, N.N., Chuyen, B.M., Nhung, P.T.H., Thang, T.D., Anh, T.T. (2021). [Enhancing risk management culture for sustainable growth of Asiatic commercial bank -ACB in Vietnam under mixed effects of macro factors](#), *Entrepreneurship and Sustainability Issues*, 8(3).
- Hang, T.T.B., Nhung, D.T.H., Hung, N.M., Huy, D.T.N., Dat, P.M. (2020). [Where Betais going—case of Viet Nam hotel, airlines and tourism company groups after the lowinflation period](#), *Entrepreneurship and Sustainability Issues*, 7(3).
- Hang, N.T., Tinh, D.T., Huy, D.T.N., & Nhung, P.T.H. (2021). [Educating and training labor force Under Covid 19; Impacts to Meet Market Demand in Vietnam during Globalization and Integration Era](#), *Journal for Educators, Teachers and Trainers*, 12(1): 179-184. DOI:10.47750/jett.2021.12.01.023
- Huy, D.T.N. (2015). [The Critical Analysis of Limited South Asian Corporate Governance Standards After Financial Crisis](#), *International Journal for Quality Research*, 9(4): 741-764.
- Huy, D.T.N. (2012). [Estimating Beta of Viet Nam listed construction companies during the crisis](#), *Journal of Integration and Development*, 15 (1), 57-71.
- Gardner (1983), *Frames of mind: the theory of multiple intelligences*, New York: Basic Books, 1983.
- J Li, J Manafian, NT Hang, DTN Huy, A Davidyants. (2021). [Interaction among a lump, periodic waves, and kink solutions to the KP-BBM equation](#), *International Journal of Nonlinear Sciences and Numerical Simulation*
- Knowles, M.S. (1975), *Self-Directed Learning: A Guide for Learners and Teachers*. New York: Cambridge.
- Kolb, D. A. (1984). *Experiential learning: experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice-Hall.
- Kolb, David & Boyatzis, Richard & Mainemelis, Charalampos. (2001). *Experiential Learning Theory: Previous Research and New Directions*, in *Perspectives on Thinking, Learning and Cognitive Styles*.
- Lam, B.T.H. (2020), [Some methods of differentiated teaching in Mathematics for junior high schools](#), *Educational Science Journal*, pp. 105-110 vol 1, 05/2020.
- LT Hieu, DT Huong, DTN Huy, MNTP Dung, ND Trung. (2021). [Identifying learners' behavior from videos affects teaching methods of lecturers in Universities](#), *Design Engineering*, 11146-11157
- Levy, H. M. (2008). [Meeting the needs of all students through differentiated instruction: Helping every child reach and exceed standards](#). *The Clearing House*, 81, (4), 161-164.
- Muhammad Kamran (2019) [A Comparative Exploration of the Effect of Differentiated Teaching Method vs. Traditional Teaching Method on Students' Learning at 'A' level](#), *Global Social Sciences Review (GSSR)* Vol. IV, No. I
- Mackey, A., Gass, S., & McDonough, K. (2000). [How do learners perceive interactional feedback?](#) *Studies in Second Language Acquisition*, 22, 471-497. <http://dx.doi.org/10.1017/S0272263100004022>
- Manning, S., Stanford, B. & Reeves, S. (2010). [Valuing the advanced learner: Differentiating up](#). *The Clearing House*, 83(4), 145-149.
- Myers, I., & McCaulley, M. (1985). *Manual: A guide to the development and use of the Myers-Briggs type indicator*. Palo Alto: Consulting Psychologists. Google Scholar
- ND Trung, DTN Huy, TH Le, DT Huong, NT Hoa. (2021). [ICT, AI, IOTs and technology applications in education-A case with accelerometer and internet learner gender prediction](#), *Advances in Mechanics* 9 (3), 1288-1296
- NT Hoa, DTN Huy, ND Le Thi Thanh Huong, NTD Trung. (2021). [Analysis of Case Teaching Method in Universities-An Economic Case Study in Pyrolysis Project](#), *Design Engineering*, Issue 7
- NTH Lan, DTN Huy. (2021). [Developing students' mathematical competence through equipping them with necessary knowledge about metacognition-and activities in teaching mathematics in secondary school](#), *Laplace em Revista* 7 (3B), 24-35

- NTT Ha, PN Van, DTN Huy. (2021). [Opportunities and challenges for vietnam society and labor market when signing evfta agreement](#), Elementary education Online 20 (4)
- Thuy, P. Đ. C. (2011). Responsibility and chalenges of Vietnamese educators and learners in project-based learning. Educational Science Journal, (31), 145.
- Razavi, A. R. (2014). Learning styles and teaching; University of Nottingham.
- Reid, J. (1995). Learning styles in the ESL/EFL classroom. London: Heinle & Heinle Publishers.
- Reid, J. (1998). Affect in the classroom: problems, politics and pragmatics. In J. Arnold (Ed.), Affect in Language Learning. Cambridge: Cambridge University Press.
- Rubin, J. (2011). The study of cognitive process in the second language learning. Applied Linguistics, 2, 117-131. <http://dx.doi.org/10.1093/applin/2.2.117>
- Salgado, Jesus. (1997). The Five Factor Model of personality and job performance in the European community. Journal of Applied Psychology. 82. 30-43. 10.1037//0021-9010.82.1.30.
- Saucier, G., & Goldberg, L. R. (1996). Evidence for the Big Five in analyses of familiar English personality adjectives. European Journal of Personality, 10, 61–77.
- Sondergeld, T. A., & Schultz, R. A. (2008). Science, standards, and differentiation: It really can be fun! Gifted Child Today, 31(1), 34-40.
- Scott, W. (2002). Adaptive teaching practices: Teacher response to upper primary students experiencing difficulties with reading. Unpublished Ph.D. thesis. Victoria University
- Sternberg, R. J. (1985). Beyond IQ: A triarchic theory of human intelligence. New York: Cambridge University Press.
- Tao Van An (2019), Teaching method in Vietnam: tradition and innovation, Ho Chi Minh Open University Journal of Science.
- Teachout, D. J. (2001). The relationship between personality and the teaching effectiveness of music student teachers. Psychology of Music, 29(2), 179-192.
- TH Le, DTN Huy, VXT Do Thu Huong. (2021). [Solutions To Enhance Students' Awareness In E-Learning Training-And Technical Application For Education Quality Enhancement At Colleges And Universities](#), Design Engineering, 7648-7659
- Thuy Kieu Phuong, Chi Trung Nguyen, Ha Ho Cam, Self-directed learning readiness for Vietnamese students in Informatics., Innovation for sustainable education in the changing context, Hanoi, 2021.
- Tomlinson, C. A. (1999). The differentiated classroom: Responding to the needs of all learners. USA, Alexandria, VA: Association for Supervision and Curriculum Development.
- Tomlinson, C. A. (2000) Differentiation of instruction in the elementary grades. Clearing house on elementary and early childhood education, ERIC DIGEST, Retrieved April 10, 2015, from <http://education.ky.gov/educational/diff/Documents/tomlin00.pdf>.
- Tupes, Ernest C., and Raymond E. Christal. "Recurrent personality factors based on trait ratings." Journal of personality 60.2 (1992): 225-251.
- Tuyên, T. D. (2007). Traditional and modern teaching methods, Vietnam Education Press.
- V Van Chung, MBADTN Huy, PDDT Ngu. (2021). [Eastern philosophical theories and marxism-lenin philosophies in viet nam society and education](#), Review of International Geographical Education Online 11 (8), 1586-1591
- VQ Nam, DT NGOC HUY. (2021). [Solutions to Promote Startup for the Youth in Minority and Mountainous Region of Thai Nguyen Province-Vietnam](#), Journal of Contemporary Issues in Business and Government 27 (3), 2113-2118
- Vietnam General Education Curriculum (2018) – *Informatics Curriculum*, Vietnam Ministry of Education and Training program