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Proposing A Framework To Assess The Intellectual Development And Competence Of Vietnamese Students Based On Sternberg's Triarchic Theory Of Intelligence

Phuong Lan Thi Nguyen[1] , Cuong Huu Nguyen[2*] , Cuong Xuan Dang[1] , Huong Thu Thi Duong

[1]Research Division on Educational Assessment, Vietnam Institute of Educational Sciences

[2]Department of Quality Assurance, Van Lang University

*Corresponding author: cuong.nguyenhuu@vlu.edu.vn

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Abstract

Intellectual development means the growth of a child's ability to think and reason. It's about how they organize their minds, ideas and thoughts to make sense of the world they live in. The government of Vietnam requests the education sector to develop hidden competencies of students, particular young learners. This study therefore analyses associated literature to propose a framework to assess the intellectual development and competence of Vietnamese students based on Sternberg's triarchic theory of intelligence. The paper discusses the theory of multiple intelligences and types of intelligence; the development of assessment framework, development path and tools to measure students' intelligence and capacity; and test results on intellectual ability and capacity development of students.

Keywords: Intellectual development; theory of multiple intelligences; Single intelligence; Sternberg's theory

1. Introduction

The Central Executive Committee issued Resolution No. 29-NQ/TW dated November 4, 2013 on fundamental and comprehensive renovation of Vietnam's education and training (hereinafter referred to as Resolution No. 29). The overall goal of the renovation process is "Educating Vietnamese people to develop comprehensively and bring into full play the potential and creative ability of each individual...". In which, one solution is "Continue to strongly and synchronously innovate the basic elements of education and training in the direction of attaching importance to developing learners' qualities and capacities".

Corresponding author.

E-mail address: cuong.nguyenhuu@vlu.edu.vn

Thoroughly grasping the above policy, the Government issued Decision No. 44/NQ-CP dated June 9, 2014 on the Government's Action Program to implement NQ29 (hereinafter referred to as NQ44). Clause 3, Article II of this Decision defines the task of "Implementing and renovating the

educational program towards developing learners' capacity and quality; practice skills in applying knowledge; develop creativity and self-study".

Thereby, it can be seen that the Government of Vietnam is demanding the education sector to promote the potential of learners on the basis of implementing an educational program to develop learners' capacity, and educational outcomes must be evaluated. prices based on advanced criteria in the world. To be able to unleash the potential and capacity of learners, it is important to have tools built on the theory of multiple intelligences.

This article deals with (i) Multiple intelligences theory and the type of intelligence being studied; (ii) Design assessment framework, development path and tools to measure students' intelligence and capacity; (iii) Test results on intellectual ability and capacity development of students.

This is the research result of the project "Building a toolkit to assess the intellectual development of high school students to meet the requirements of promoting personal potential in the spirit of Resolution 29-NQ/TW", code No. KHGD/16-20.ĐT.045, belonging to the National Science and Technology Program for the 2016-2020 period "Research and develop educational science to meet the requirements of fundamental and comprehensive renovation of education education in Vietnam", code: KHGD/16-20.

2. Theoretical framework

2.1. Theory of multiple intelligence

From the middle of the 20th century and earlier, the term "Intelligence" used to refer to human intelligence when discovering things and phenomena. Since the second half of the 20th century, this term has been understood to mean (i) learning capacity, (ii) abstract thinking capacity, (iii) adaptive capacity, of which the third sense is common. (according to Freeman, Frank S (1963) and Aiken LR, (1987) After that, the context of globalization changed the intellectual conception of world psychologists: human psychology (including intelligence) has a social nature, rather than a closed structure, innately inherited; and intelligence is both the result of interaction and a prerequisite for human interaction with the environment (Nguyen Cong). Khanh 2010).

There are two types of intellectual development theory, Single intelligence and Multiple intelligence (Figure 1). The Mono-mind approach considers intelligence to be a general ability "g" (general), which can be divided into two separate factors "s" (special) according to Charles Spearman (2005), or seven separate factors according to Charles Spearman (2005). Thurstone (1938), or multi-hierarchical arrangement according to Vernon (1969). In contrast, the Multiple Intelligences approach holds that there is not one common factor, but many intellectual factors. Guilford theory (1967) has 120 factors of intelligence, Howard Gardner (1999) theory has 10 types of intelligence (language, logic - math, music, space, physical, internal, communication, natural). , survival and philosophy).

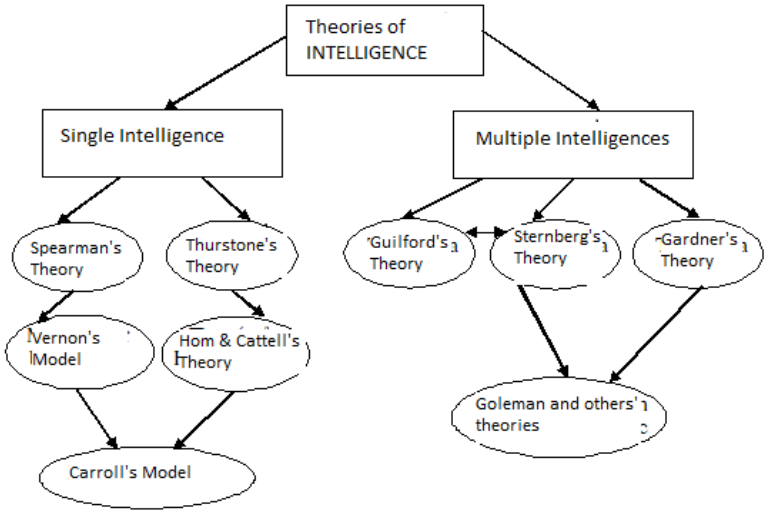

Figure 1. Generalized diagram of theories and models of intelligence

At the end of the 20th century, a trend of practical intelligence research (Practical Intelligence, PI) and social intelligence (Social Intelligence, SI) appeared. Since then, Eysenck has proposed a three-conception model: biological intelligence, psychometric intelligence or academic intelligence, and social intelligence. Figure 2 depicts the three-conception model and their factors (Eysenck (Ed) 1985).

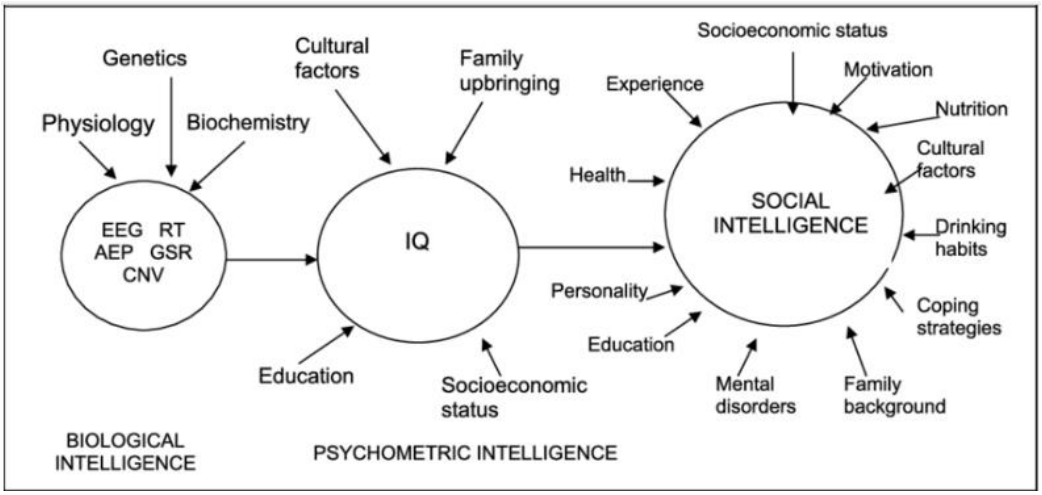

Figure 2. Three conceptions of intelligence (Eysenck, 1985)

Robert Sternberg stated the concept of "successful intelligence" on the basis of developing three components: (a) analytical intelligence (the capacity of thinking, reasoning, language, problem solving, evaluate, etc.); (b) practical intelligence (the ability to operate in real situations); and (c) creative capacity (ability to combine experiences, events, discoveries, imagination, predictions, etc. in new ways) (Sternberg 1999) (Figure 3).

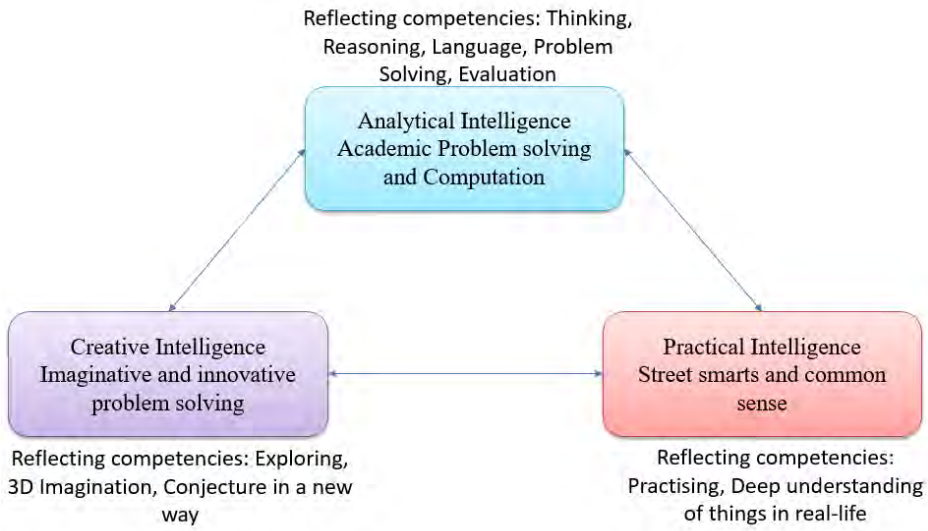

Figure 3. Sternberg's triarchic theory of intelligence

The Sternberg's Triarchic Abilities Test (STAT) assesses the elements of Analytical, Creative and Practical. Each of these elements will have 3 sub-tests in the fields of Language, Quantification and Spatial Image, which are denoted as: I. Analytical-Verbal; II. Analytical-Quantitative; III. Analytical-Figural; IV. Creative-Verbal; V. Creative-Quantitative; VI. Creative-Figural; VII. Practical-Verbal; VIII. Practical-Quantitative; and IX. Practical-Figural (Weng-Tink Chooi, Holly and Lee 2014).

There are two types of tests: STAT-A for people from16 years olf, which consists of 36 items and time for completion is 45-50 minutes; and STAT-C for people of 10-15 years old, which consists of 90 items and time for completeion is 50-55 minutes.

Table 1. Structure of Sternberg's STAT-C Test

Factors / Areas	Analytical	Creative	Practical	Total
Verbal	I: 10 questions	IV: 10 questions	VII: 10 questions	30
Quantitative	II: 10 questions	V: 10 questions	VIII: 10 questions	30
Figural	III: 10 questions	VI: 10 questions	IX: 10 questions	30
Total	30	30	30	90

2.2. BEAR Assessment System

According to the Berkeley Evaluation and Assessment Research (BEAR), a good assessment must guarantee 4 principles, including developmental perspectives, matching between instruction and assessment, management by teachers through providing regular feedbacks and supervisions, evidence of high quality assessment. The four building blocks that embody them, are shown in Fig 4: (i) Establishing the hypothetical construct map (based on previous research and assessment); (ii) Designing measurement items/ tasks based on different levels of hypothetical development; (iii) Describing the output space of given items/ tasks; (iv) Developing the demonstrated competence maps for students.

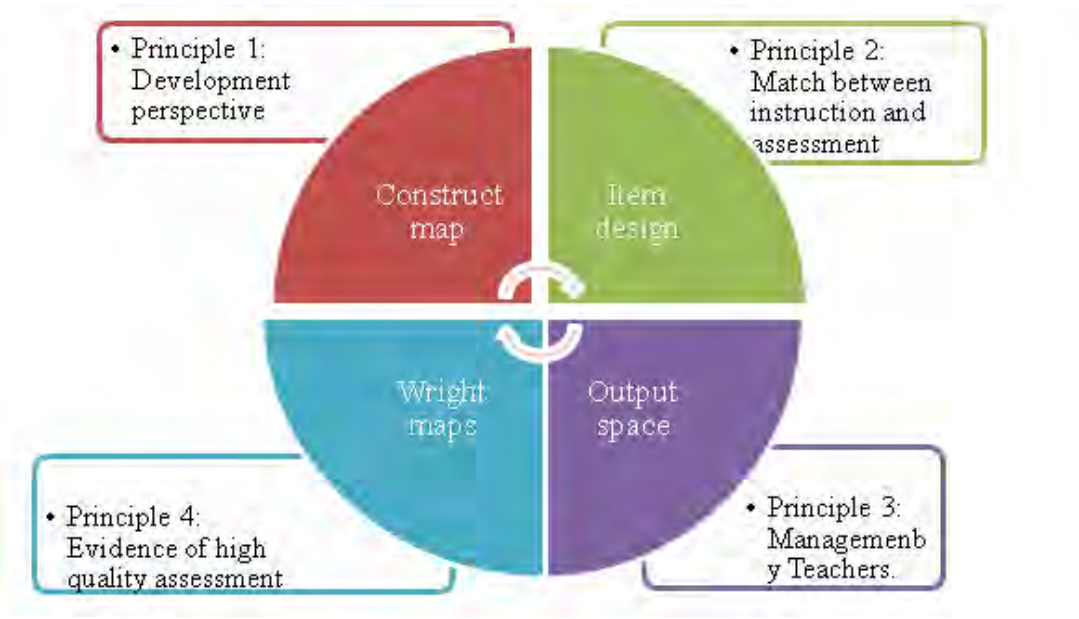

Figure 4. Different principles and stages of the BEAR Assessment System

Similarly, the development assessment framework proposed by Griffin (2014) as shown in Figure 5: starting from defining competencies, then dividing competencies into components, components, behavioral indicators and quality criteria.

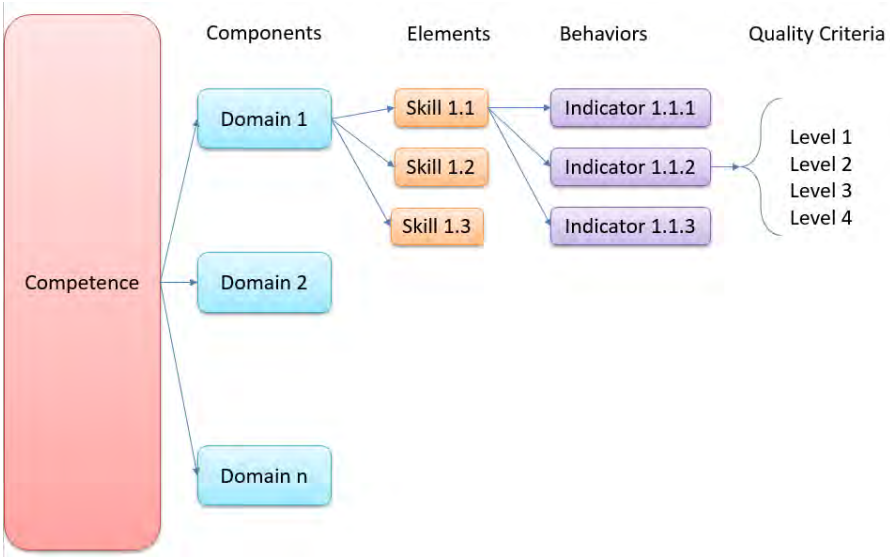

Figure 5. Griffin's (2014) development assessment framework

3. Results

3.1. The model of intellectual connection and capacity of Vietnamese high school students

Based on Eysenck's three-tiered model of intelligence, we link the development of both intelligence and competence specified in the 2018 general education curriculum as shown in Figure 6.

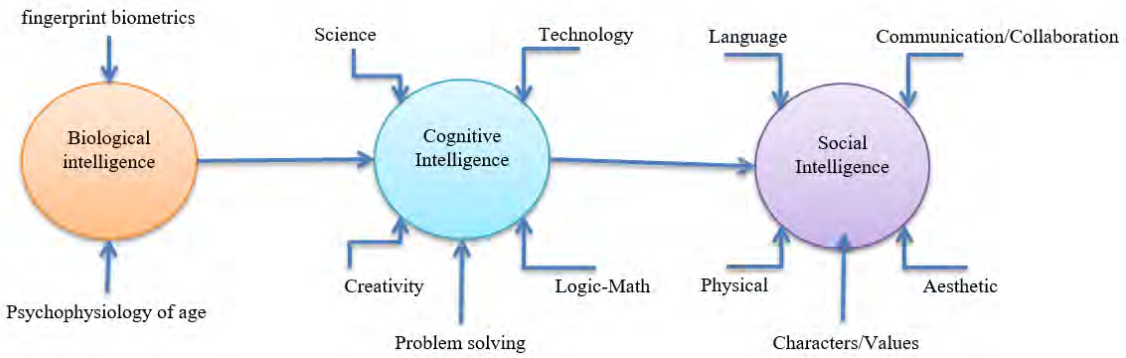

Figure 6. Eysenck's three-tiered model of intelligence

We selected the minds in Sternberg Triarchic Theory of Intelligence because: (i) Analytical, Creative and Practical Intelligences contribute to the framework of 21st century skills; (ii) Sternbreg has specified in which capacities each type of intelligence is expressed and used; (iv) Scientists have modeled Sternberg's 'intelligence' using the multi-level factor method; (v) Sternberg developed the STAT-A and STAT-C measures of intellectual ability for all ages.

The multi-level model for assessing students' intelligence and ability is depicted in Figure 7: (i) General intellectual ability 'g'; (ii) the three intelligences of Analysis, Creation and Practice; (iii) Problem Solving, Creative Logic-Mathematics, Language and Collaboration competencies; (iv) question blocks measuring capacity and intelligence.

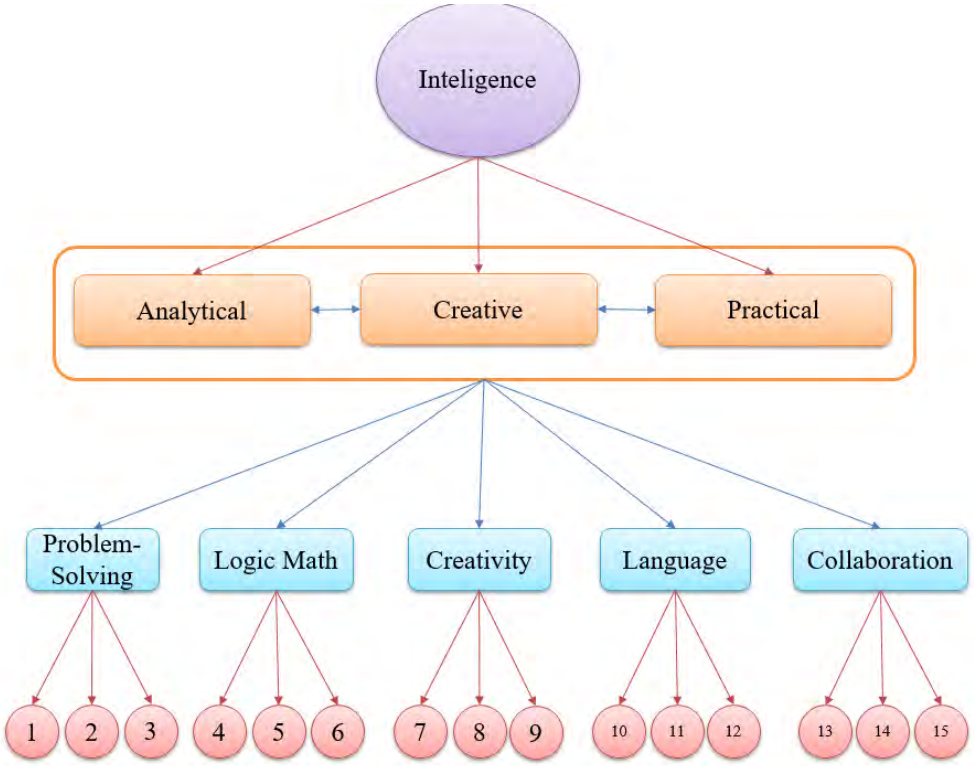

Figure 7. Multilevel model of assessment of intelligence and competence based on Sternberg's theory

3.2. Building a framework for intellectual development and student capacity

On the basis of the BEAR model and the development framework of Griffin (2014), the research team has built the intellectual development path and the capacity development path according to the following

steps: (i) Modeling latent variables (defining concepts and structures) capacity architecture; outline the capacity development path); (ii) Design questions/tasks to measure those levels of development; (iii) Design the performance result space; (iv) Modeling the student's competency index and adjusting the development path.

The results of phase (i) have conceptualized, structured and outlined the development path for the competencies of Language, Logic-Math, Problem Solving, Creativity and Cooperation.

Phase (ii) designed the tool based on a three-dimensional matrix with a total of 270 questions distributed across 23 blocks. Component intelligences: Analysis (including blocks of questions I, II,…, VIII) has 80 questions; Creativity (including blocks of questions IX, X, etc. XV) has 57 questions; and Practice (including question blocks XVI, XVII,…, XXIII) has 121 questions. Areas: Speech has 130 questions; Quantification has 48 questions; and Spatial Imagery has 92 questions. Competencies: Language includes 60 questions belonging to Bock I, II, IX, XV and XXII; Logic-Math includes 60 questions belonging to Bock IV, VI, VII, XX and XXI; Problem solving includes 48 questions belonging to Bock V, XII, XVIII and XIX; Creation of 33 questions belonging to Bock X, XIII and XVI; Cooperation has 69 questions belonging to Bock III, VIII, XI, XIV, XVII and XXIII (see Table 2).

Table 1. Technical criteria for overall student intelligence survey

	Analytical	Creative	Practical	**Total**
Verbal	I. Language 12 Reading - Writing	IX. Language 12 Tự luận (mở)	XV. Language 12 Reading - Writing	**36**
	II. Language 12 Essay (Open)	X. Creative 9 Essay (Open)	XVI. Creative 15 Essay (Open)	**36**
	III. Cooperative 16 Likert	XI. Cooperative 9 Likert	XVII. Cooperative 21 Likert	**46**
			XVIII. Problem-solving 12 Reading - Writing	**12**
Quantitative	IV. Logic - Math 12 Reading - Writing		XIX. Problem-solving 12 Reading - Writing	**24**
	V. Problem-solving 12 Reading - Writing		XX. Logic - Math 12 Reading - Writing	**24**
Figural	VI. Logic - Math 12 Multiple choice	XII. Problem-solving 12 Essay (Open)	XXI. Logic- Math 12 Multiple choice	**36**
	VII. Logic - Math 12 Multiple choice	XIII. Creative 9 Essay (Open)	XXII. Language 12 Multiple choice	**33**

	VIII. Cooperative 4 Likert	XIV. Cooperative 6 Likert	XXIII. Cooperative 13 Likert	**23**
Total	**80**	**57**	**121**	**270**

Phases (iii) and (iv) analyzed data from 1283 pilot students from the three provinces of Quang Ninh, Vinh Phuc and Thua Thien Hue. In which, 442 students of grade 5, 442 students of grade 9 and 399 students of grade 11. Some methods and techniques were used such as: sizing questions and tests according to Rasch model and IRT theory; determine the cut-off scores using the Audit skill technique.

Below is a summary of two important results of the above process: intellectual and capacity development path, assessment of students' intellectual development and capacity.

a) The development lines/patterns of general intelligence 'g' and four competencies are described in tables 3, 4,..., 7.

Table 3. Description of general intelligence levels ‘g’

Level	**Description**
1	At this level, students can recognize and notice activities that need to be completed, as well as ask relevant questions. Make basic predictions about an object's characteristics. Utilize some simple reasoning techniques to reach conclusions about common objects and occurrences. Analyze the similarities and contrasts between two things and come up with a solution to a basic issue. Discover the details that help them understand the meaning of simple language. They can recognize images and their meanings with the use of basic visuals.
2	Students at this level may discuss and assess the viability of alternative solutions in basic scenarios. Provide straightforward new solutions based on the analysis and synthesis of data sources. Transform between straightforward models (tables, drawings, words). Analyze the similarities and contrasts between two things and use the information to solve basic issues. Determine the image's significance by seeing it and connecting it to the paragraph. Connect, decode the meaning of basic text visuals, and generate new concepts in simple scenarios.
3	Students at this level may remark on and assess the viability of alternative solutions in straightforward scenarios. Begin the process of giving a solution to a basic issue in two phases by deducing qualities, making observations, and describing objects and occurrences. Determine if an item has (or does not possess) specified properties. Analyze and explain similarities/differences between topics using a mix of knowledge. Analyze/interpret information included in a text. Assessing difficulties related with characters' adventures, establishing connections between images and words, developing ideas as well as suggesting and implementing solutions, and understanding how to generalize simple items and events encountered
4	Students at this level may generalize rules; re-evaluate viable solutions to basic issues; and begin the process of giving a two-step solution to a simple problem. Conduct an analysis of academic settings. Recognize and describe some of the most prevalent features of various items. Determine the causal link between objects and events in somewhat complicated situations. Make a practical link to the text's issue. Investigate alternative possibilities, therefore resolving the issue. Analyze and describe the characteristics/attitudes of individuals. Convert data comparisons into practical meaning by formulating and executing ideas in rather difficult settings.
5	At this level, students may develop the necessary strategies by using a variety of skills. Utilize a range of tactics to assist them in resolving reasonably complicated situations. Develop ways for generalization and abstraction to address moderately complicated challenges. Propose novel

	thoughts and projections that are out of the norm, that are not (identical to) the actual reality. Infer, state (prove) attributes, make observations, and provide descriptions of objects and occurrences. Determine the causal link between objects and events in somewhat complicated situations. Connect creativity and reality by generating and executing novel ideas in somewhat challenging circumstances using a unique technique.
6	Students at this level are capable of analyzing difficult circumstances and posing pertinent academic queries. Can identify and explain complicated items, convey important personal lessons via textual material, and discover and explain the structure of objects and events. Provide answers to challenging problems, develop, and execute new ideas using a variety of ways in circumstances that are complex or unfamiliar to them.

Table 4. Description of levels of Logic-Math

Level	**Description**
1	At this level, students can make some rudimentary predictions about the attributes of an item, understand how to utilize some simple inference tools, and examine similarities and differences across things. In certain basic circumstances, use the "complete search" strategy, which is based on information gained via the senses.
2	At this level, students can recognize an item with or without a certain feature, employing a single piece of knowledge to compare things in basic settings using information gained via the senses. There are relatively reasonable changes between simple models at this level (tables, drawings, words).
3	At this level, students can use a combination of knowledge to analyze and explain similarities and differences between objects, infer the properties of an object or phenomenon based on its similarity to another object or phenomenon according to some criteria, make observations, detect, and explain situations in which simple objects can be classified according to given attributes based on visual representations, and make comments.
4	Students at this level may deduce, confirm (prove), and remark on qualities. Classify items based on a specified property, avoiding visual models. Determine the causal link between objects and events in reasonably complicated situations
5	At this level, students can recognize the structure of objects and phenomena and model them. Determine if a complicated statement is true or untrue. Infer, state (prove) characteristics, make observations, and describe objects and occurrences. Determine the causal link between objects and events in complicated situations.
6	Students at this level can utilize inference tools flexibly to derive inferences about objects and phenomena in common situations. Describe and categorize items based on their characteristics. Utilize a mix of age-appropriate information to identify and explain subject-to-subject similarities/differences. In complicated settings involving a large number of items and interactions, use reasoning to reach conclusions about things and phenomena.

Table 5. Description of Levels of Language

Level	**Description**
1	At this level, students can detect features in order to deduce the meaning of language and recognize symbols and their associated meanings via visual representations.
2	At this stage, students can sequence information; they can see visuals and connect them to texts to deduce meaning. Utilize the right definitions for all terms in the text. Analyze the primary

	substance of straightforward text. Connect information to discover the language's meaning. Analyze/explain information contained in a text
3	Students at this level can determine the true reason based on the presented circumstances. Connect the textual content. Replace the substance of a sentence with another sentence. Practical relevance to the text's central issue. Analyze and describe the characteristics/attitudes of a character. Analyze the text's aesthetic value. Determine the true reason based on the description of the scenario.
4	At this level, students can comprehend the meaning of textual information, give an acceptable solution using proper language, choose the most appropriate remedy for the text's issue, and resolve difficulties involving textual characters. Additionally, they establish a connection between the pictures in the paintings and the real expression and draw practical consequences from data comparisons.
5	At this level, students may express their own reactions to the visuals in the text; Interpret/analyze data included in a somewhat complicated document; Make a statement on the link between images in photographs and actual life; Present a personal lesson drawn from the text's substance and significance; Analyze the significance of linguistic symbols; Compose character recommendations on their own initiative.
6	At this level, students are able to identify the primary content/circuits in complex texts; relate complicated corpora to reality; and connect creativity to reality.

Table 6. Description of levels of problem solving

Level	**Description**
1	At this level, students can recognize and detect chores that need to be completed; they can also ask pertinent inquiries. Utilize approach to resolve straightforward issues
2	Students at this level may remark on and assess the viability of potential options in straightforward scenarios. Analyze and synthesize data from a variety of academic contexts; Provide straightforward new solutions based on the analysis and synthesis of data sources
3	At this level, students may begin the process of giving answers in two phases for easy issues; they can also provide new solutions based on previously collected data; and they can provide fresh ideas. Conduct an analysis of academic settings; Identify simple problems; develop rules; review viable solutions to simple problems
4	At this level, students may generate new answers based on previously developed solutions; use strategy to tackle complicated issues; and employ a range of abilities to develop the appropriate methods. Conduct an analysis of academic settings; Identify issues; Develop mechanisms for generalization and abstraction to address relatively complicated situations
5	At this level, students may begin the process of providing answers to rather complicated issues with only two stages; Provide novel solutions based on current data; Present novel ideas; Create rules; reevaluate potential tactics; Analyze events and raise pertinent academic concerns
6	Students at this level are capable of identifying and developing a two-step solution to a complicated issue; Create guidelines; re-evaluate alternative solutions for dealing with complicated circumstances

Table 7. Description of Levels of Creative Thinking

Level	Description
1	Students may generate a modest number of ideas (1-2) that are all related to the same subject and include known themes. Consider the work from a single viewpoint, without regard for any task aspects that may be altered or for alternate views or paths. Present thoughts that are appropriate for the situation. The possibilities for combining and kneading components are restricted.
2	Students generate a range of thoughts that may be classified into three recognized categories. Evaluate ideas from best to worst using a pre-defined criterion; highlight the solution's overall strengths and weaknesses. The majority of operations are routine, focused on identifying apparent aspects of the activity and repeating old ideas rather than developing new ones. Provide a detailed idea without evaluating its efficacy or justifying its appropriateness.
3	Students generate a range of ideas that differentiate each other. Can shift viewpoints, think differently about a task/problem, and see the task/problem through a variety of typical lenses. Students analyze each option and choose the one that best satisfies each requirement; they identify criteria that are not met by the solutions; and they identify the advantages and disadvantages of certain ideas and solutions based on their characteristics or results. Present a detailed idea that is both fit for purpose and effective, and with an evaluation of effectiveness or an explanation of fitness for purpose
4	Develop some distinct ideas or approaches on the subject or method that are independent of the student's social environment. Students are eager to explore, expanding their horizons and exploring new possibilities. To overcome any roadblocks, ask questions and converse about the task's scope. Experiment with a variety of methods, even some that do not seem to work. Evaluating each solution against defined comprehensive criteria; identifying and comparing the many advantages and disadvantages of alternatives to decide which solution provides the most desired outcomes and fulfills the most preferred criteria. Flexible thinking is required to shape components. Connect the assignment's aspects effectively to provide fresh options or other ways of thinking about the work.

* The development of students' intelligence

Figure 8 is a Wright map of the distribution of students' general intelligence factor 'g' and component intelligences with the item difficulty. It can be seen that there is a relatively standard balance between the distribution of the ability of students and the item difficulty, indicating that this instrument is rather excellent.

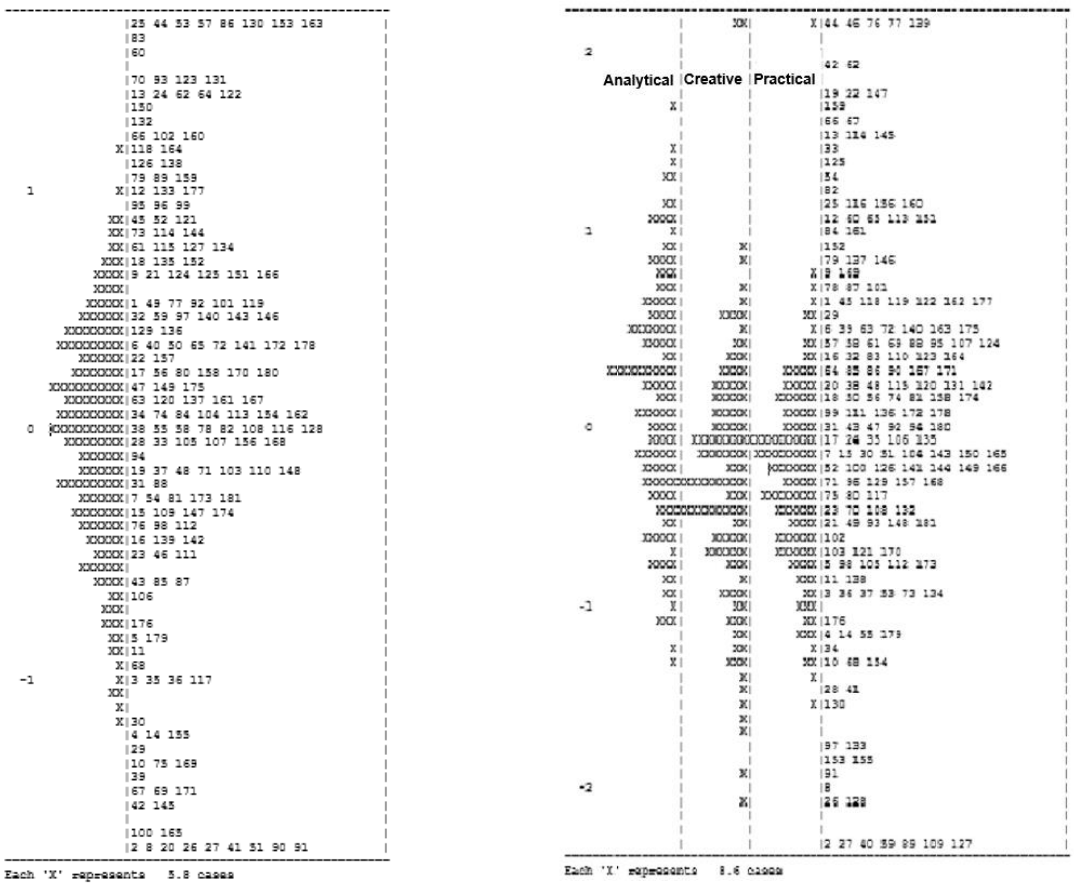

Figure 8. Item-person maps on general intelligence and component intelligences

For general intelligence 'g,' between 40% and 50% of students achieve levels 3 and 4, whereas only 12% achieve high levels 5 and 6. Over half of students achieve levels 2/4, 3/ 6, and 4/6 in Creative, Practical, and Analytical intelligence.

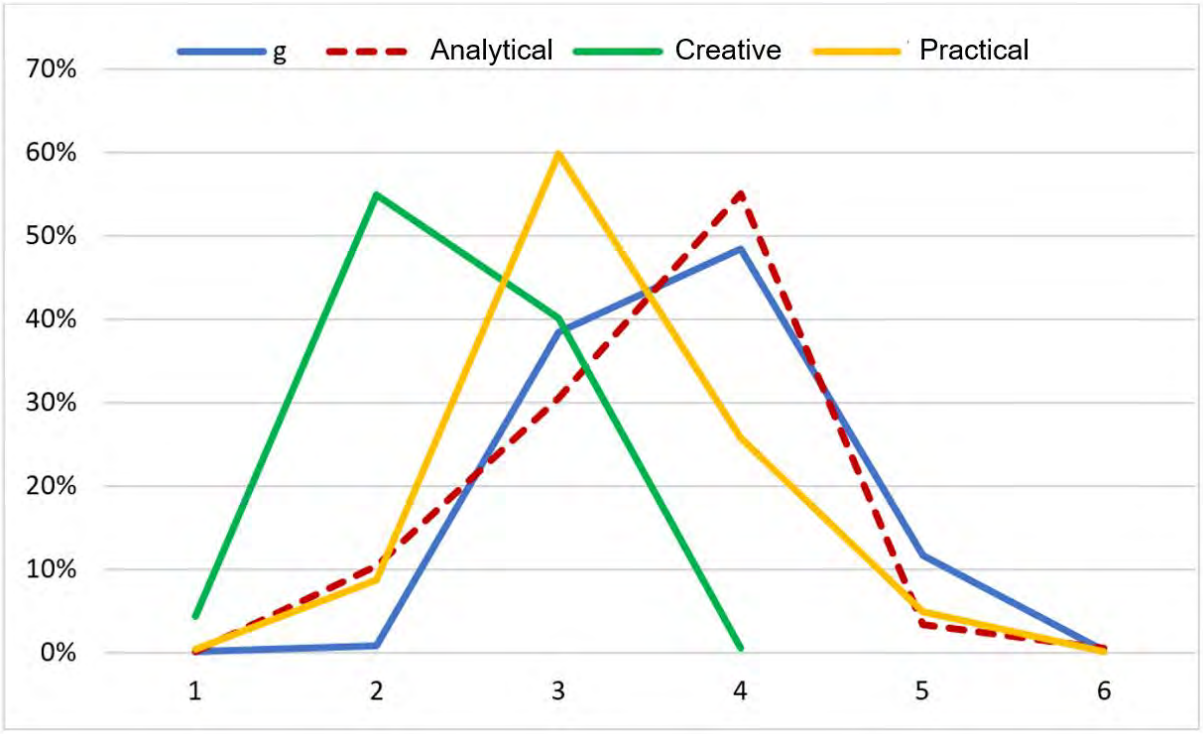

Figure 9. Vietnamese students' intellectual growth level

For general intelligence 'g', Level 3 was most prevalent in grades 5, whereas Level 4 was most prevalent in grades 9 and 11. No ninth graders attained Level 6, while just 0.3 percent of fifth graders attained level 6. (See Figure 10).

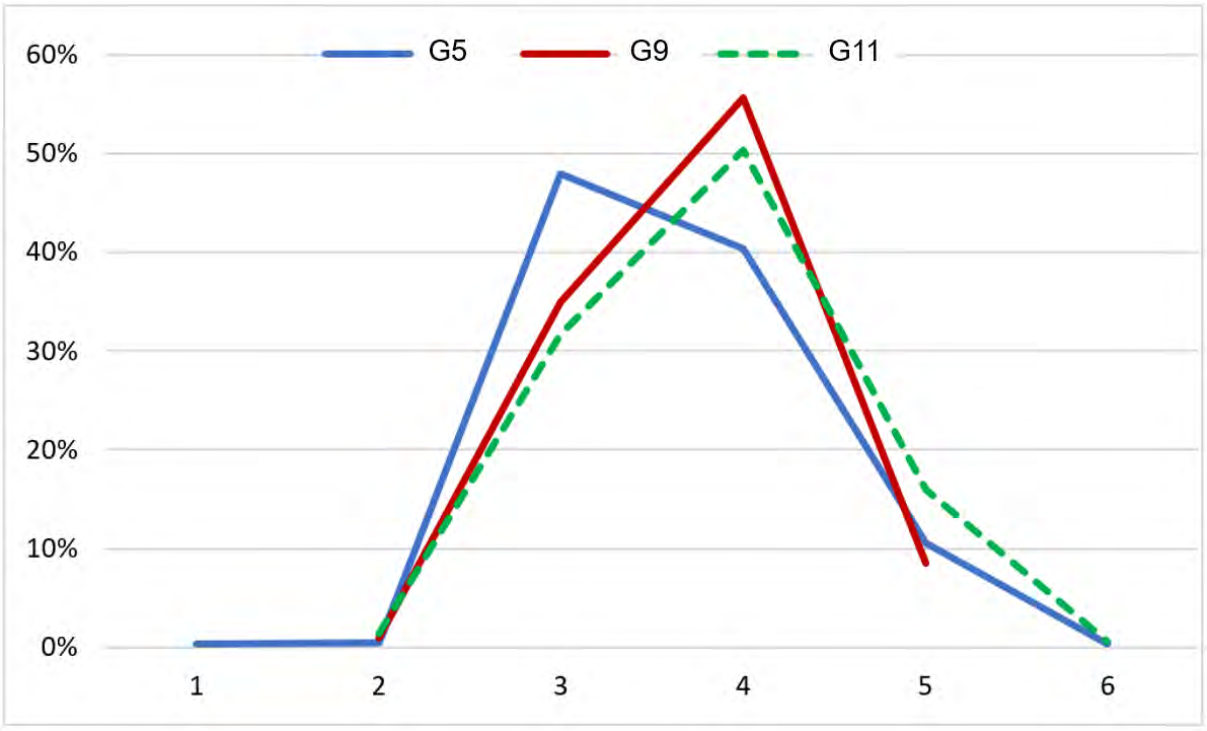

Figure 10. General level of intellectual development 'g' by grade

* Development of students' ability

Figure 11 is a map of the distribution of students' Logical-Math, Language, Problem Solving and Creativity Thinking with the item difficulty. It can be seen that there is a relatively standard balance between students' ability and the item difficulty, which indicates that this is a good instrument for measuring students' competencies.

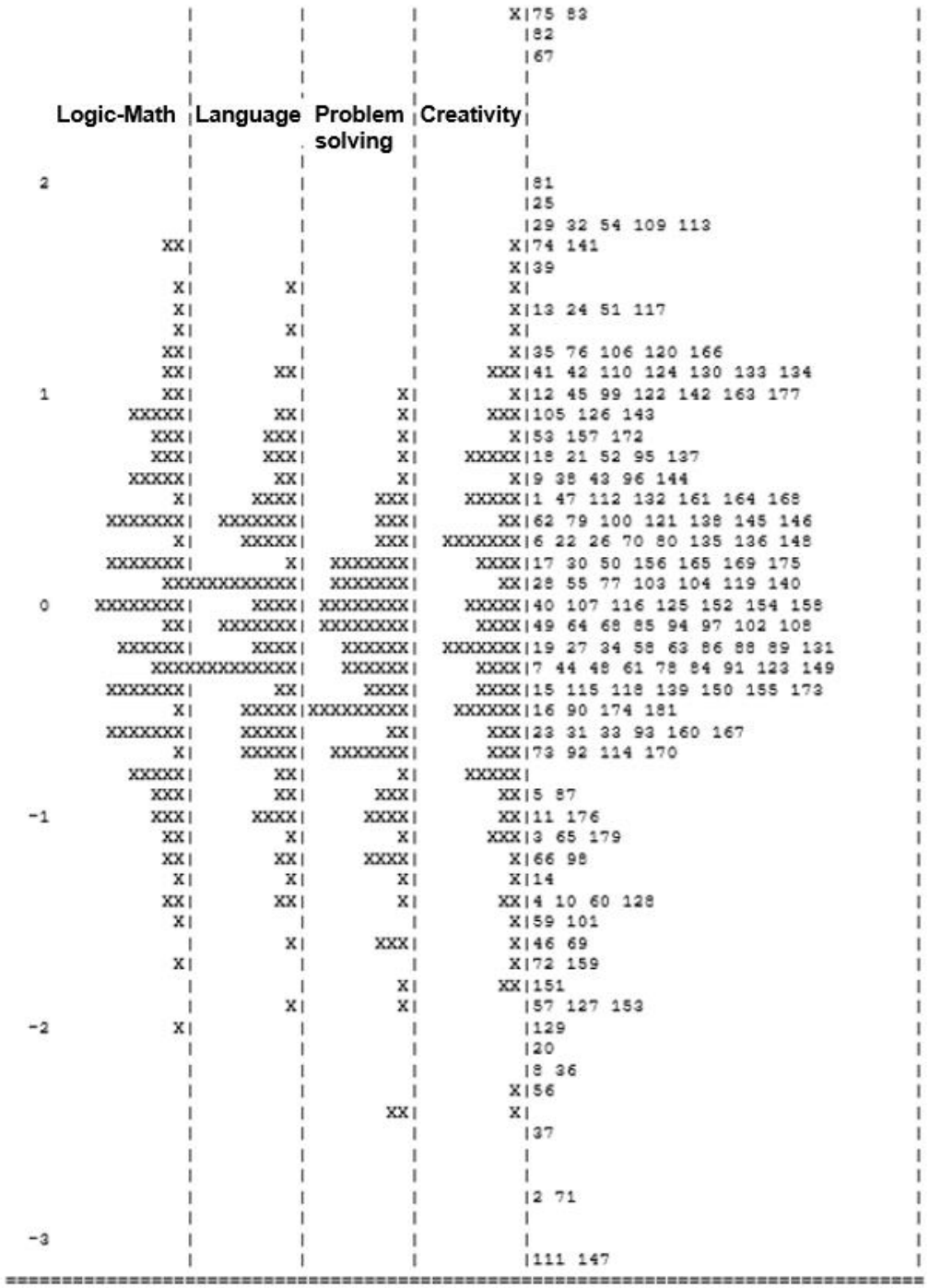

Figure 11. A Wright map for the multidimensional intelligence model

The majority of students (80%) achieved levels 3 and 4 in Problem Solving and levels 5 and 6 in Logic-Math (see Figure 12). The development of creative thinking exemplifies the best balance of the four capacities (the difference between levels 1 and 4 is about 16 percent).

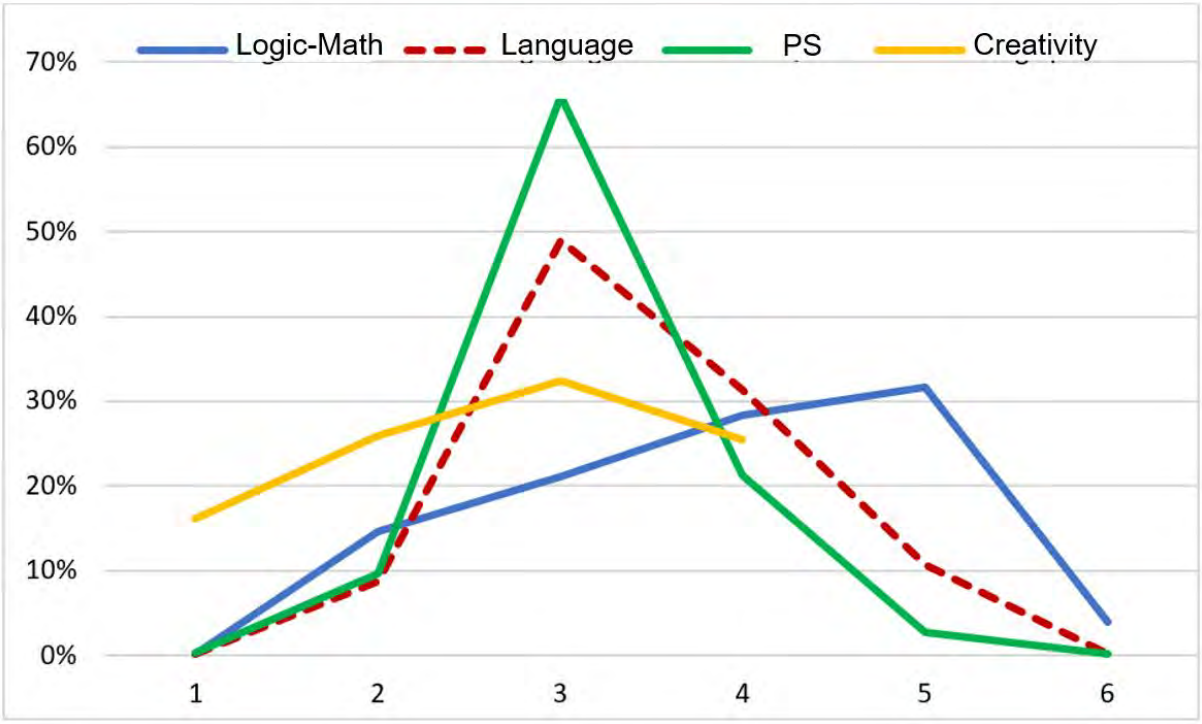

Figure 12. Level of development of students' competencies

Comparing grades reveals that 5th students' development level is lower than that of 9th and 11th graders in all competences, whereas 9th graders seem to be more competent than 11th graders. Only 0.3 percent of fifth-graders have attained the Problem Solving level 6. (see Figure 13).

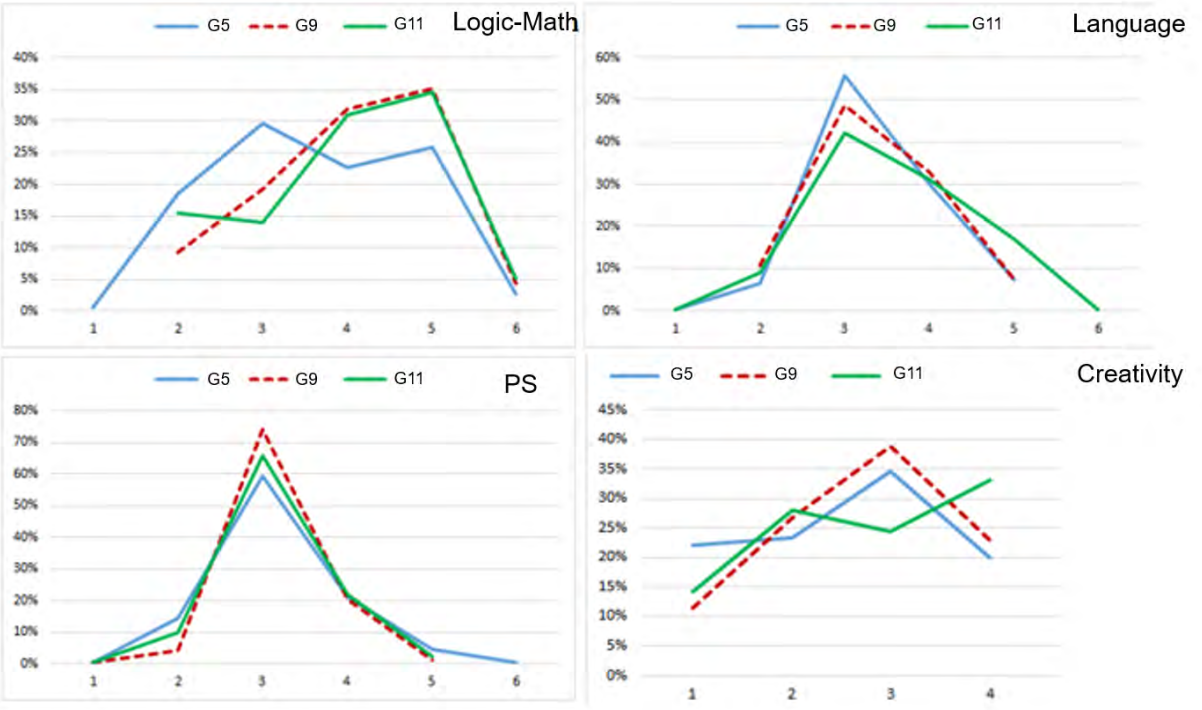

Figure 13. Levels of students' capacity development by grade

4. Conclusion

Eysenck's theory of intelligence and Sternberg's Triarchic Theory of intelligence are linked to the key competencies of the Vietnamese general education curriculum in order to enhance both the intelligence and capacities of learners concurrently.

The BEAR assessment model (Wilson & Sloan, 2000) and the competence development framework (Griffin, 2014) are both excellent recommendations for constructing learning continuums for general intelligences (i.e., Analytical, Creative, and Practical) and competencies (i.e., Language, Logic-Math, Problem Solving, and Creativity).

The suggested assessment instrument, based on Sternberg's STAT structure, has 23 item blocks that test both intelligences (i.e., Analytical, Creative, and Practical) and competencies (i.e., Language, Logic-Math, Problem Solving, and Creativity). This enables a more accurate assessment of the student's potential and progress. The acquired findings have bolstered the study team's confidence in its ability to implement the suggested assessment framework and instruments on a national scale.

The research findings have aided in the development of pedagogical interventions aimed at maximizing individual potential, meeting the capacity development requirements of the new general education curriculum, and contributing to the achievement of the objectives of fundamental and comprehensive education and training reform.

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