

# Effects of Synchronous Web-Based Instruction on Students' Thinking Styles and Creativity

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Technology and innovation are the power of human civilization. In face of such a changeable era, the rapid development and circulation of information technology has hastened the diversification of society. To cope with the approach of information society, teaching methods should also be changed, as traditional injection education could no longer adapt to the changing society. Different from the face-to-face lecturing in traditional classrooms, learners at different places could still precede "face-to-face" like instruction through synchronous web-based instruction. It is expected to promote students' creativity. Taking teachers and students of public and private universities in Kaohsiung City as the sampling subjects, 600 copies of questionnaires are distributed. Total 428 valid copies are collected, with the retrieval rate 71%. The research results are concluded as following. 1. Synchronous web-based instruction would affect thinking styles. 2. Synchronous web-based instruction would influence creativity. 3. Thinking styles reveal notably positive effects on creativity. The research results and suggestions are expected to have teachers change the teaching methods in order to promote students' creativity.

*Keywords:* synchronous web-based instruction, thinking styles, creativity, application of technology, teaching method

## INTRODUCTION

Technology and innovation are the power of human civilization. In such a sharply changing era, information technology is rapidly developed and circulated and the diversification of societies is hastened. People are facing Third Industrial Revolution, a Knowledge Economy Era determined by Brain. In this case, the cultivation of creativity is the most important human resource. In order to reinforce the competitive advantages of the citizens in the changeable era, comprehensively promoting creativity in a planned way is an essential trend. Innovation could be regarded as the process of knowledge production, knowledge utilization, and knowledge dissemination, while creativity is the trigger of innovation. Creativity education therefore becomes a key promotion in the future.

The 21st century is the society with information technology and knowledge economy. To cope with the approach of information society, teaching methods should also be changed. Traditional injection education could no longer adapt to the

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changing society. In addition to inherit traditions, the new should be brought forth from the old.

Furthermore, it is inadequate to simply rely on Wisdom in the rapidly changing trend. When traditional thinking could not be got rid of to create new situations, more knowledge and wisdom would be useless.

It will be the key in surviving and succeeding in the 21st century to thoroughly develop personal creativity potential. Curriculum innovation therefore manifests that the cultivation of creativity should be rooted from education. Cultivating students' creativity by cultivating the creative thinking abilities of active exploration and research, independent thinking, and problem solving as well as innovative talents with national competitiveness reveals that students could apply the knowledge and skills to guide several concepts and ideas through creative thinking and to practice them for producing actual products. Accordingly, teachers should promote Creativity so that students could face the future with competitiveness. It is considered as the research motivation. Different from face-to-face lecturing in traditional classrooms, it is expected to precede synchronous web-based instruction through synchronous platforms in this study. By combining personal computers with the Internet, learners at various locations could still precede "face-to-face" like group thinking to simulate each other for the chain effect, expecting to promote students' creativity.

## DISCUSSION OF LITERATURE AND HYPOTHESIS

### Synchronous web-based instruction

Combining the Internet with computer related software and hardware allow teachers and learners at different places proceeding teaching and learning activities at the same time through the functions of instantaneity and bilateral communication provided by electronic equipment (Al-Rahmi & Othman, 2013). Under synchronous web-based environments, teachers and students can get on the Internet at the same time proceeding instant interactive learning activities through the tools in synchronous network platforms, such as audio or video conference, electronic whiteboard, chatroom, and stream media (Cheung et al., 2011). Interaction is a key in effective learning and information exchange. The major characteristic of synchronous e-learning is to simulate the face-to-face interaction in traditional classrooms through audio and video interaction tools (Deng & Tavares, 2013). In synchronous instruction, teachers could transmit teaching materials, voice, and images through multimedia to students as well as receive students' video and responses. Such multimedia presentation breaks through the text communication and allows students and teachers at different locations getting closer so as to reduce the loneliness of individual learning and enhance learning effect (Coiro, 2011). Synchronous e-learning environments could not be restricted the space as in Traditional Classrooms and could reduce the time and cost travelling back and forth

### **State of the literature**

- To cope with the approach of information society, teaching methods should also be changed.
- Traditional injection education could no longer adapt to the changing society.
- To discuss the effects of synchronous web-based instruction on students' thinking styles and creativity

### **Contribution of this paper to the literature**

- To cultivate students' analytic and comparison abilities. Teachers should provide more analytic and comparison practice.
- Students with different thinking styles present distinct preference. For example, legislative ones like to design their ways of doing things and make decisions on their own, executive ones tend to follow rules, accept instruction, and do as being instructed, or judicial ones are interesting in offering opinions and giving analyses and remarks.
- Teachers are suggested to help students understanding personal thinking styles through the thinking style scale and daily observation of students' behaviors in order to have students match thinking styles with the abilities and develop personal potentials.

schools. Both teachers and students could achieve the interactive effect as face-to-face instruction simply by combining personal computers and the Internet and effectively applying the tools provided by synchronous network platforms, such as chatroom, electronic whiteboard, audio or video conference, and virtual classroom, at the same time (Harasim, 2012). When the lessons are preceded to a section, teachers could ask students questions to understand the learning conditions, and students, when facing questions in the lessons, could immediately propose questions to teachers or discuss with peers for responses and solutions. Such an instantaneous interaction allows teachers control the teaching situations and adjust the teaching contents and pace.

Referring to the synchronous e-learning model proposed by Jong et al. (2014), the dimensions of role (teacher, learner), participation way (individual, group), participation place (appointed place, any places), interactive mode (one-way, two-way), and course delivery method (playing video of instructional contents, real-time instruction, mix) are applied to this study (Junco, 2012).

1. Role: The role of synchronous e-learning contains teachers and learners, and the sole requirement is that both teachers and students have to get in the virtual classroom at the same time.
2. Participation way: The participation way for synchronous e-learning includes individuals and groups, i.e. students could learn individually or discuss and cooperatively learn with a group of people.
3. Participation place: In synchronous e-learning, the place to participate in lessons could be appointed places or any places. Teachers and students, with individual demands, could precede online teaching and learning activities at different locations, i.e. having more personal and flexible learning space and environments. However, the learning process might be interfered or interrupted externally, such as phone calls or other people (Kim et al., 2012).
4. Interactive mode: The interactive mode for synchronous e-learning could be one-way transmission, like real-time broadcasting, or two-way interaction, such as online live discussion between teachers and students and among students.
5. Delivery method: The course delivery method in synchronous e-learning might be teachers playing video of instructional files, online live instruction, or the mix of the two.

### **Thinking styles**

Thinking styles refer to individual attitudes towards matters; they are not abilities, but the preferred ways of individuals developing the intelligence (Arteaga et al., 2014; Özyurt, 2015), i.e. individual preference or tendency when using the cognition ability. Sternberg and Lubart (1995) indicated that thinking styles did not have the problem of good or bad, but simply adapted to the problems, demands, and situations at the time; therefore, people who were regarded “incapable” at schools or workplaces were simply because of the thinking styles not suitable for the environments. Harrison and Bramson (1985) pointed out thinking styles as the way individuals making decisions to comprehend affairs, generate questions, and solve problems; in other words, distinct thinking styles referred to different people presenting various opinions, cognition, and solutions when encountering problems. Coiro (2011) classified human’s thinking styles into synthesist, idealist, pragmatist, analyst, and realist and considered that people were likely to tend to certain thinking styles and ignore the others.

Referring to Cheng’s (2012) Theory of Mental Self-Government, thinking styles are classified into function, form, level, scope, and leaning, which are divided into 13 dimensions, including legislative, executive, and judicial in function level, monarchic,

hierarchic, oligarchic, and anarchic in form level, global and local in range level, internal and external in scope level, and liberal and conservative in tendency level. Each person would tend to certain category of thinking styles at each level, i.e. different levels in the same category of thinking styles. The characters of thinking styles at each level are described as below.

1. Function level, referring to personal thought and mode of operation. 1. Legislative: Innovators to create new situations, who like to do things with personal modes, prefer dealing with problems not being preset, are good at presenting personal creativity, and do not like to engage in unchangeable things. 2. Executive: Conformable executors, who follow rules, are willing to deal with present problems, like to follow orders, are glad to accept instructions, like to engage in structured tasks, and know the roles and tasks. 3. Judicial: Judicators good at analyses and evaluation who like to evaluate rules, procedures, and things requiring analyses, such as proposing personal opinions and criticizing others, and like the work which allows expressing personal opinions. Students with judicial thinking styles are not popular at schools that they could hardly develop the abilities (Lin et al., 2012).
2. Form level: referring to personal self-management attitudes towards problem solving. 1. Monarchic: Concentrating on things, doing the best, but easily being persistent. 2. Hierarchic: Dealing things with the priority, considering problems from different aspects, and defining correct handling sequence. 3. Oligarchic: Not being able to distinguish the importance of things and feeling insufficient time and resources when encountering several things. 4. Anarchic: Randomly giving strategies to deal with problems, not being restricted by systems, and presenting unexpected solution and creativity (Liu, 2012).
3. Range level: referring to a point when an individual dealing with matters. 1. Global: Preferring broader and abstract questions, not stressing on details, and generally making trivial mistakes. 2. Local: Preferring to solving specific problems of details, being pragmatic and discussing things case by case, and often making trivial mistakes.
4. Scope level: referring to the interactive relationship with others when dealing with matters. 1. Internal: Presenting introvert personality, paying attention to the obligation, preferring to work alone, and being lack of group sense. 2. External: Showing lively and extrovert personalities, in favor of social, and being flexible in interpersonal relationship.
5. Tendency level: referring to individual thinking when dealing with matters. 1. Liberal: Favoring to break existing rules and steps, seeking for excitement, and easily showing short interests. 2. Conservative: Preferring to follow preset rules and steps, avoiding ambiguous conditions, and insisting on familiar work fields.

## Creativity

Belanger et al. (2011) defined creativity as the psychological process to surpass existing experiences, break through the restriction of habits, and form new concepts in problematic situations as well as not to be restricted to practice and the supernormal abilities to flexibly apply experiences to solve problems. Creativity used to be explained with creativity 4P, as process, persons, product, and press/place. 1. Process: To analyze the emergence and process of creativity and focus on exploring creativity generating process and stages. 2. Persons: To present creators' personality traits, where the research results are different because of distinct research tools. 3. Product: Creativity as the ability to generate unique, novel,

proper, and valuable products, aiming at the standards to define products or work creativity (Daniel et al., 2012). 4. Place/press: To investigate the effects of environments or pressure on creativity performance.

Clark & Mayer (2011) regarded creativity performance as the interaction among skills in relative fields, skills related to creativity, and work motivation. Flisher (2010) pointed out creativity as the interaction process among individual people, domain, and field. Referring to Huang et al. (2012), creativity is regarded, in this study, as the transformation of an individual or a group and the performance on cognition, affection, and will, which allow oneself, individual, and created field getting in higher changes. Creativity generally contains several cognitive abilities of divergent thinking, which could be understood through testing tools or evaluators' observation (Hawi, 2012).

1. Fluency. Fluency refers to the number of concepts generated by a person; i.e. the ability to propose several possibilities or solutions for one question. A student's thinking presents fluency when proposing several responses at the stage of concept generation (Hsieh et al., 2011).
2. Flexibility. Flexibility refers to the ability of an individual changing the thinking direction, i.e. finding out different applications or new concepts with various thinking methods when encountering problems. That is, an individual could adapt to various conditions and treat problems without using inherent habitual and rigid thinking methods. "Flexible changes", "learning by analogy", and "comprehending by analogy" are the specific performance of flexibility.
3. Originality. Originality refers to the ability of an individual being able to come out with unique and novel ideas, i.e. to do unexpected things or presenting abilities different from others. The person could come out with different ideas from others even receive the same stimulus as the others do. When fewer people are the same, the originality is enhanced, such as the performance of "little green leaves red", "outstanding", and "prominent".
4. Elaboration. Elaboration, as a supplementary idea, refers to individual ability to add new ideas in existing concepts, i.e. increasing novel concepts or composing relevant ideas in inherent ideas or basic concepts. "Making progress" and "searching for excellence" could be used for describing elaboration (Pa& Huang, 2011).

### Research hypothesis

Roths et al. (2014) proposed several thinking skills to enhance creativity; free association and deferring judgment were effective methods for promoting individual or group creative thinking, in which participants released their opinions under pleasant and intimate atmosphere and acquired large quantity of creativity in short period through group thinking and opinion stimulation (Floropoulos et al., 2010). Nonetheless, traditional face-to-face meetings could easily result in obstacles, criticism and worries, restricted free thinking, and social chatting (Huang et al., 2013). Spek et al. (2011) indicated that the development of information technology and the improvement of network bandwidth offered an environment suitable for synchronous e-learning. Through the tools and functions on synchronous network platforms, such as electronic whiteboard, participants' voice and images, live text chatroom, and live speech, not only could the instant face-to-face interactive effect be achieved, but the above problems would be reduced. The following hypotheses are therefore proposed in this study.

H1: Synchronous web-based instruction would affect thinking styles.

H2: Synchronous web-based instruction would influence creativity.

In the research on the performance and effects of thinking styles and creativity, Seo & Woo (2010) discovered that different thinking styles would actually affect individual creativity. Most research (Irwin et al., 2012; Jeong, 2011; Joo et al., 2011) found out the better creativity performance of people with legislative thinking styles. Terzis & Economides (2011) pointed out the correlation between learners' thinking styles and creativity. Chen (2002) indicated that legislative and judicial thinking styles could assist in the development of creativity. Legislative thinking styles and judicial thinking styles could effectively discriminate creativity performance. Wang & Chiu (2011) proposed the significant correlation between legislative, judicial, anarchic, integral, liberal thinking styles and creativity. Regarding the group science creativity, Wang et al. (2010) pointed out the better individual creativity of legislative and judicial students in mixed thinking style group. Hawi (2012) discovered that legislative pupils presented more science creativity. Legislative pupils could present their opinions in the creative thinking process, executive pupils would search for assistance from others, and judicial pupils would take the prior experiences as the reference. Accordingly, the following hypotheses are proposed in this study.

- H3: Thinking styles present significantly positive effects on fluency of creativity
- H4: Thinking styles reveal remarkably positive effects on flexibility of creativity.
- H5: Thinking styles shows notably positive effects on originality of creativity.
- H6: Thinking styles appear significantly positive effects on elaboration in creativity.

## RESEARCH METHOD

### Research framework

Summing up the above literatures, the conceptual framework (Figure 1) is drawn in this study to discuss the relationship among synchronous web-based instruction, thinking styles, and creativity.

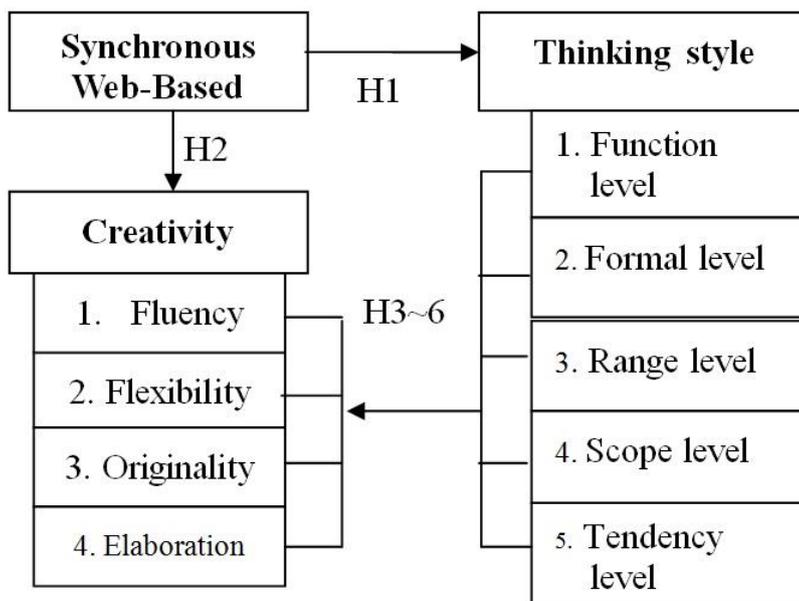


Figure 1. Research framework

## Measurement of research variable

### *Thinking styles*

Referring to Cheng (2012), five dimensions are included in thinking styles, namely (1) function level, (2) formal level, (3) range level, (4) scope level, and (5) tendency level.

### *Creativity*

Referring to Huang et al. (2012), (1) fluency, (2) flexibility, (3) originality, and (4) elaboration are covered.

## Research subject and sampling data

Public and private universities in Kaohsiung City are selected as the research subjects in this study, containing National Sun Yat-sen University, National Kaohsiung Normal University, National University of Kaohsiung, Kaohsiung Medical University, I-Shou University, and Shih Chien University (Kaohsiung Campus). By distributing and collecting questionnaires on sites, teachers and students in the public and private universities in Kaohsiung City are proceeded questionnaire survey in this study. Total 600 copies of questionnaires are distributed, and 428 valid copies are collected, with the retrieval rate 71%. SPSS is utilized for the data analyses, and Factor Analysis, Reliability Analysis, Regression Analysis, and Analysis of Variance are applied to test the hypotheses.

## Analysis method

Applying Analysis of Variance to discuss the difference of synchronous web-based instruction in thinking styles and creativity, Regression Analysis is further used for understanding the relationship between thinking styles and creativity.

## ANALYSIS RESULT

### Analysis of reliability and validity

With Factor Analysis, five factors are extracted for thinking styles, including Function (eigenvalue=2.946,  $\alpha=0.80$ ), Formal (eigenvalue=2.662,  $\alpha=0.84$ ), Range (eigenvalue=2.038,  $\alpha=0.87$ ), Scope (eigenvalue=1.834,  $\alpha=0.81$ ), and Scope (eigenvalue=1.531,  $\alpha=0.89$ ). The accumulative covariance explained reaches 80.916%.

With Factor Analysis, four factors are extracted for creativity, containing Fluency (eigenvalue=2.438,  $\alpha=0.83$ ), Flexibility (eigenvalue=2.155,  $\alpha=0.88$ ), Originality (eigenvalue=1.827,  $\alpha=0.85$ ), and Elaboration (eigenvalue=1.392,  $\alpha=0.90$ ). The accumulative covariance explained achieves 82.423%.

### Effects of synchronous web-based instruction on thinking styles and creativity

#### *Difference analysis of synchronous web-based instruction in thinking styles*

The difference of synchronous web-based instruction in thinking styles is discussed with Analysis of Variance that role, participation way, participation place, interactive mode, and delivery method in synchronous web-based instruction are analyzed and explained. From Table 1, role, participation way, participation place, interactive mode, and delivery methods present remarkable differences on thinking styles that H1 is supported.

**Table 1.** Difference analysis of synchronous web-based instruction in thinking styles

Variable	Function		Formal		Range		Scope		Tendency	
	P	Scheffe	P	Scheffe	P	Scheffe	P	Scheffe	P	Scheffe
Role	0.022*	1>2	0.016*	1>2	0.004*	1>2	0.018*	1>2	0.036*	1>2
Participation ways	0.000*	1>2	0.044*	2>1	0.027*	2>1	0.000*	1>2	0.008*	2>1
Participation places	0.038*	1>2	0.000*	2>1	0.000*	1>2	0.037*	1>2	0.011*	1>2
Interactive modes	0.000*	1>2	0.000*	2>1	0.000*	2>1	0.000*	2>1	0.000*	2>1
Delivery methods	0.000*	1>23	0.002*	23>1	0.000*	23>1	0.006*	23>1	0.000*	23>1

\* stands for  $p < 0.05$

**Table 2.** Difference analysis of synchronous web-based instruction in creativity

Variable	Fluency		Flexibility		Originality		Elaboration	
	P	Scheffe	P	Scheffe	P	Scheffe	P	Scheffe
Role	0.247		0.312		0.183		0.422	
Participation ways	0.022	1>2	0.046	1>2	0.377		0.264	
Participation places	0.083		0.026*	2>1	0.271		0.835	
Interactive modes	0.000*	2>1	0.000*	2>1	0.000*	2>1	0.000*	2>1
Delivery methods	0.005*	23>1	0.000*	23>1	0.017*	23>1	0.000*	23>1

\* stands for  $p < 0.05$

**Difference analysis of synchronous web-based instruction in creativity**

The difference of synchronous web-based instruction in creativity is investigated with Analysis of Variance that role, participation way, and participation place in synchronous web-based instruction are analyzed and explained. Table 2 reveals the notable differences of role, participation way, and participation places on creativity that H2 is partially supported.

**Correlation Analysis of thinking styles and creativity**

**Correlation Analysis of thinking styles and fluency**

The test result of H1, Table 3, shows significant effects of function ( $t=1.636^*$ ), form ( $t=1.573^*$ ), range ( $t=1.844^*$ ), scope ( $t=1.732^*$ ), and tendency ( $t=1.915^*$ ) on fluency that H3 is supported.

**Correlation Analysis of thinking styles and flexibility**

The test result of H2, Table 3, presents remarkable effects of function ( $t=1.657^*$ ), formal ( $t=1.768^*$ ), range ( $t=2.326^{**}$ ), scope ( $t=2.075^{**}$ ), and tendency ( $t=1.873^*$ ) on flexibility that H4 is partially supported.

**Correlation Analysis of thinking styles and originality**

The test result of H3, Table 3, reveals notable effects of function ( $t=2.048^{**}$ ), formal ( $t=1.966^*$ ), range ( $t=2.271^{**}$ ), scope ( $t=2.166^{**}$ ), and tendency ( $t=1.615^*$ ) on originality that H5 is supported.

**Correlation Analysis of thinking styles and elaboration**

The test result of H3, Table 3, appears significant effects of function ( $t=2.415^{**}$ ), formal ( $t=2.186^{**}$ ), range ( $t=1.978^*$ ), scope ( $t=2.091^{**}$ ), and tendency ( $t=1.887^*$ ) on elaboration that H6 is supported.

**Table 3.** Analysis of thinking styles and creativity

Dependent variable→ Independent variable↓	Creativity							
	Fluency		Flexibility		Originality		Elaboration	
Thinking styles	Beta	t	Beta	t	Beta	t	Beta	t
Function	0.157	1.636*	0.156	1.657*	0.197	2.048**	0.233	2.415**
Formal	0.146	1.573*	0.161	1.768*	0.188	1.966*	0.207	2.186**
Range	0.172	1.844*	0.206	2.326**	0.213	2.271**	0.189	1.978*
Scope	0.165	1.732*	0.194	2.075**	0.202	2.166**	0.191	2.091**
Tendency	0.183	1.915*	0.177	1.873*	0.151	1.615*	0.176	1.884*
F	18.422		21.375		27.168		29.833	
Significance	0.000***		0.000***		0.000***		0.000***	
R2	0.262		0.283		0.314		0.368	
Adjusted R2	0.021		0.027		0.030		0.34	

Remark: \* stands for  $p < 0.05$ , \*\* for  $p < 0.01$ . Data source: Self-organized in this study

## CONCLUSION

The research results show remarkable effects of thinking styles on creativity. The synchronous e-learning environment provides favorable personal thinking space and could effectively reduce interference among classmates. Moreover, with the assistance of synchronous platforms, direct face-to-face conversation is not necessary in synchronous e-learning environments that the face-to-face conversation pressure is reduced, students feel free and are more easily to speak out the ideas, and teacher-student interaction is enhanced. Meanwhile, utilizing synchronous web-based instruction for expressing opinions allow students making statements with typing or drawing pictures, when others are giving opinions with audio. Besides, teachers or students could share files to immediately share voice, pictures, and even films with each other to make learning media richer. In this case, each student has the same opportunity to make statements. What is more, it is convenient and fast for teachers dealing with teaching materials or handouts so as to rapidly update teaching materials and avoid losing handouts. In traditional classes, the time is occupied by the students who are making statements; others who would like to express opinions have to wait for the right to speak. Since the environment allows parallel speech, each student can fairly make statements.

## RECOMMENDATION

Aiming at above research results, the following suggestions are made in this study.

1. To cultivate students' analytic and comparison abilities. Teachers should provide more analytic and comparison practice, such as group discussion, in the instruction and give students opportunities to discuss questions and express opinions; or, teachers, without criticizing students' opinions, could propose open-end questions and encourage students to deliver personal opinions in the instruction and cultivate students' analytic and comparison

- abilities. Students with potentials of technology creativity would need analytic and judgment abilities to help them put into practice.
2. Aiming at students with various thinking styles to use different instructional strategies. Students with different thinking styles present distinct preference. For example, legislative ones like to design their ways of doing things and make decisions on their own, executive ones tend to follow rules, accept instruction, and do as being instructed, or judicial ones are interesting in offering opinions and giving analyses and remarks. To give considerations to students with distinct thinking styles, teachers have to frequently change the instructional strategies. For instance, lecturing is more suitable for students with executive thinking styles, group learning, discussing problems, and expressing opinions is suitable for students with judicial thinking styles, and teachers proposing questions from instructional contents are suitable for students with legislative and judicial thinking styles. Moreover, the application of multiple evaluations could help understand students' abilities.
  3. To help students realize personal thinking styles. Teachers are suggested to help students understanding personal thinking styles through the thinking style scale and daily observation of students' behaviors in order to have students match thinking styles with the abilities and develop personal potentials. Legislative students who like to design the ways to do things and make decisions by themselves but present insufficient creation ability might be misunderstood as disobedient or naughty. In this case, teachers should thoroughly accept the students and actively help and guide them to adjust the thinking styles or promote the creative abilities.

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