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Promises on Language Oriented Approach of Science and Technology Teaching

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Abstract: On the basis of five years of teaching practice, the author puts forward Language Oriented Approach (LOA) of teaching programming skills. This paper presents the author's follow-up research works, based on the previous conclusion, the author extracts Language Oriented Approach of Science and Technology Teaching from Language Oriented Approach of teaching programming skills. The author briefly expounds the principles, connotation and extension of the LOA. Moreover, the method system of the LOA is analyzed into six distributions. Two of them have been developed, forming up special methods. Others are on the way. The ChatGPT can be allocated into the LOA structure so as to better the application of AI in education. Inventor's language method also can be allocated into the LOA structure to be shown as a way of effect enhancement. The future applications of the LOA are also prospected.

1. Introduction

In teaching of Computer Science subjects, most college students majoring in computer science or software in China could not get on the trace, and had difficulty in learning. More than half of them cannot work in their majors after graduation. I reason it to the main measure of college to solve the teaching quality problem which is styled as universal template for University to design the curriculum system based on computational thinking[1]. Faculty have taken unremitting efforts for 20 years. However, reality prove that that method has not worked into effect after 20 years of use.

That method is developed under the influence of Professor Jeannette M. Wing, Dean, Department of Computer Science, Carnegie Mellon University. In 2006, she published an article and gave the academic concept of "computational thinking"[1]. Based on the principles of this article, the course design of computer related majors in universities have been improved their curriculum design, some basic courses have been added into curriculum to cultivate computer thinking. For two decades, those are main measures for faculty leaders to improve the quality of teaching.

As a supplement from grass-roots teacher, I am used to trying to solve quality problems from the standpoint of teaching methods, by contrast with the department head who always tries to solve problems from the design of training programs. These are two levels of efforts to improve teaching

quality. The propagation and diffusion modes of the two are different, former's transmission are training programs from one school to another school, and the latter's transmission are teaching methods from one teacher to another teacher. I believe the effect of a teacher's correct grasp of teaching methods is far greater than the effect of an optimized training program. Therefore, the role of teachers in talent cultivating could not be ignored, because front-line workers are more likely to grasp the truth of the problem.

After five years pursuit of effective and efficiency in teaching reform, I switched my teaching strategy to Language Oriented Approach (LOA) in 2018.In this method, textbook and study materials are chose from all language version for suitability; problem sets are used in chosen language; teaching executes with bilingual or chosen language; teacher is communicating with students in inventor's native language; professional operating environment is demonstrated in experimental scenes; Etc.[2].

In practice, I took on the tutor of the software engineering class 2 of 2017 and achieved excellent results. After four years of teaching reform, in the 24 members class, students who got jobs in big companies or big cities had doubled than ordinary, with overt 30% substantial increase in salary. The number of being admitted to graduate school reach to 5, highly exceed the average enrollment rate 5% of the whole grade 2017.

Many colleagues in grassroots level from all over the world have put forward good suggestions, such as identifying distinctly four implicit skills for novices[3], using adaptive learning system of programming tools[4]. Some radicals apply 4 Phases Of Inquiry-Based Learning method to programming teaching for reform[11][12],etc. Their views are looks from teaching model aspect, from classification of basic abilities of learning of each student etc. However, I gave a special attention to the facts that teacher has the choice of languages, and the teaching ineffectiveness is due to the inappropriate or even incorrect in the language used in teaching.

In Chinese education, the use of original English teaching materials can be dated from the late Qing Dynasty when it was 160 years before. What I have done is generating and lifting it to methodological level to use. The main measures are addressed as I mentioned above. I engage in it because using this approach is more effective than using strategies of computational-thinking-courses-based curriculum design.

2. Learning Theories Exploring on Software Programming

Teaching Programming is different from the teaching in other majors. The main task of teaching in other majors is to ensure students' knowledge acquisition, while programming teaching focuses more on helping students acquire skills and ability of coding, which let students be able to write codes that realize certain functions. This kind of teaching is often situational, vocational, to some great extent. For future's job adaption to the working environment, students should complete learning in same or similar scenario. Gain of the capability of coding means that one can get into a new competence realm, get into a new talent position that adapts to software development. Once students face the situation of confusion of not being able to do it, many are helpless and have a blank look, which is a situation that the average ignoramus often encounter in a new environment. The reason why those happens is because the programming learning process is actually a process of learning to use tools, and if they could not use tools, they can't do anything about it. That is programming.

To teach students to code, teachers need to know how students gain the skills on the basis of existent knowledge, some situations, even on non knowledge. It seems that we need to delve deeper into this question, how could students learn successfully. Known this problem, we can carry out teaching smoothly and effectively. Additionally, in fact that a large proportion of students cannot

gain the skills they should deserve, students are encountered with the survival problem of how to keep up with the courses and participate in the projects. If they cannot keep up with the progress like other students, they will have the anxiety of not catching on.

By comparing several previous studies on learning theory[5][6][7], I conclude that constructional theory is more suitable for explaining programming learning process. Programming learning is students centered but not teacher centered. In addition to assimilating, accommodating some basic knowledge, more importantly, learners need to learn how to use tools and acquire skills for development. So leaner try to adapt to their environment in order to get in track. Through such adaptation, learner could got equilibrium with environment in sense of achievement.

I believe that the learning process of learners is much like communicating with transcendental people such as masters, parents and teachers. Therefore, teachers should design better methods to communicate with students and arrange realistic situations to implement better teaching. I trust that technology teaching is to aid students to communicate with the technology's inventor, especially, the process of students learning the principle of the processor is a process of communication with the CPU inventor, or a process of communication with the teacher when the teacher introduces the principle of the CPU to the students, and learning effects are realized in these communications.

Inspired by Vygotsky's constructivism, I have study on the communication process and it's effects in constructing. The results showed that the teaching effect depends on the communication effect between teachers and students; and the communication content is the explanation of computer science knowledge, operating skill and software products; and the learning effect depends on the degree and depth of communications between teachers and students, also the cognitive level of scientific knowledge and product standard.

In the course of communications, language is primary tool. So language is the base of communication. There is almost no problem in the situation that message sender and receptor use the same language. However, programming is invented by scientist from a few countries, while over hundred countries need to employ it and learn it. There are barriers arising anytime people with different linguistic backgrounds attempt to exchange ideas, often leading to confusion and missed connections. Language barriers hinder communication by impeding understanding due to linguistic differences, leading to misinterpretations and confusion[13].

There are several category of language barriers in which semantic barriers are significant to programming teaching. Some have big impacts, one is difference between Languages which causes the most straightforward barrier when people don't share a common language, another is Jargon and Technical Term which have specialized meaning that can exclude those who are not in the same field or industry[10].In programming teaching, these two situations overlap, even in same fields, translation distortion always occurs.

Technical language plays a pivotal role in creating barriers. Despite in same language within various industries, professionals often use jargon or industry-specific terminologies that are perplexing to outsiders and new comers. This specialized language enables precise communication among experts but becomes a barrier when conversing with those from different fields or laypersons. For example, an IT professional's use of acronyms like API or HTTP might as well be foreign to someone in the healthcare industry[9].

For Chinese, there are language and Jargon barriers in learning IT technology from foreign. Probably, so are people from many other countries. My study shows, behind different languages there are different modes of thinking. When the same content is expressed in different languages, in fact, the content is decomposed under different thinking modes. So the results of decomposition may not be the same. There is a lack of meaning in the translation process. However, in modern technology teaching, we are used to translating the original to learner's native language to acquire teaching materials. This is, in another mode to decode the original. The result may be a completely

different statement from the original one. This throws the learner into a cloud of confused, obscure words, this causes the learner to miss the point of what they should get.

Due to the evolution of translation methods, especially the hasty and emergency translation method, there are many cases where the original meaning is lost or even distorted. I will give you a few examples in the field of software engineering in China. The improper translation of technical terms such as bit, database, frame, virtual machine, etc., leaves many students confused at the beginning of their studies. Until a later careful identification for these words in their original language, the students couldn't catch the meanings. There is a high probability that these students will not get the handle although having accessed into the software programming industry, or will never get into the door at all.

Almost all IT technology originated in Europe and the United States, where English is used. Linguistically, English and Chinese are completely different languages, one is a combined order language and the other is a pictographic language. Even if in combined ordered language countries, to work with computer in one way, developers in non-English speaking need two language processes: first to convert the native language to English; second to feed the English based programming language to the machine for execution. In the first process, due to the functional defects of translation itself, the semantics will be distorted or some original meaning will be lost, which reduce the accuracy and efficiency of communication between developers and computers. Those cause programmers to present imbecile or incompetent both in knowledge acquire and programming practice.

The reason for these loss is that linguistic conventions are different from each other on the base of real cultural differences[8]. To prevent those from happening, better original language is used, rather than translation version is used. In education for Computer Science and Technology majors and other relative majors, to get effective communication, there are great needs for inventor's speaking in the class spots, or original language teaching materials, textbooks.

In teaching practice, what language the textbooks and teaching materials are expressed in? This is the primary and key issue for the Language Oriented Approach. There are different language versions of textbooks. In my practice, version is chosen by language which technology inventor's native is. In computer science and technology, most inventor come from America, England and Nordic countries, so I choose the suitable editions of the textbook in order to stay consistent with the thinking of those inventors. This is key to gain the knowledge of computer and software both for students and teachers. Once the version of the textbook has been determined, the primary problem of teaching in Language Oriented Approach has been solved. The Approach is now clear and ready to go.

3. The Principles of The Language-oriented Approach

On the basis of Constructivism, and derived from Constructivism, I figured out a new way of teaching. This new style of teaching method can optimize teaching theory and practice. We can deliver information to students with efficiency, and students can go through their courses best. Compared with the previous methods and methodologies, the latter mainly aimed at theoretical education, and the Language Oriented Approach not only has guiding significance for theoretical teaching, but also more importantly, it provides facilities for practical teaching. The main principles of this approach can be described from both teacher and student perspectives.

3.1 Principles of teaching

As described in the previous section, the purpose of teaching is towards students' learning, students complete their learning process in the procedure of teaching. From the perspective of

teaching, professional instruction executes by way of teachers' communicating with students.

The chosen of language for textbook and study materials are the key node in the Language Oriented Approach. Also problem sets, oral communicative media should use the same language accordingly. The aim of language chosen is the accuracy that should be insured in the communication between teacher and students. This is the first point.

The second point is inventor's native language. Inventor create the technology; the technology needs to be taught to students; in teaching, communicating with students need using suitable language. My study shows that in the course of imparting knowledge to student, the main matter is to pass on the ideas of the inventors of the technology. How to let students know what is the inventor's thought? The correct way is to ask the inventor. His or her thought primarily expressed in his/her native language. So we use inventor's native language.

The third is to demonstrate the target which the teaching is for. Mostly the target is how to use tools. In many cases, the target is resided in professional operating environment in experimental scenes.so the target should includes the back environment need to be set out.

The fourth is to comfort. Once the target shows up. The distance from the target will be realized immediately, seeing the big gap need to fill, students will feel nervous. By comforting, it will be done to reduce and eliminate students' anxieties, worries and depression, and to encourage students to forge ahead towards the goal. This is great beneficial to induce students seeking the space from their ready knowledge to the target.

The fifth is to construct students' skills. Guiding students to feed new challenge problems into their existing knowledge system, inducing students achieve goals, so students will improve new capabilities, and master the same skills as excellentclassmates' or teachers'.

The sixth is to impose the student to produce result and present outcome, guide the student to sublimate the new skills into ideas, and present the ideas in texts or figures or other multimedia, which can be loaded as copies of the knowledge or skills he has acquired.

In the Language Oriented Approach, the teacher is the initiator with positive, the students are followers, the teacher's role in teaching is active and primary. The aim of teachers' teaching activities is to bring students' cognition or skills to the higher level or have new improvement in idea.

3.2 Principles of Learning

The constructivist theory is based around the idea that learners are active participants in their learning journey; knowledge is constructed based on experiences. As events occur, each person reflects on their experience and incorporates the new ideas with their prior knowledge. Learners develop schema to organize acquired knowledge. This model was entrenched in learning theories by Dewey, Piaget, Vygotsky, Gagne, and Bruner[14].

Employing this theory, the implementation of programming teaching become very efficient. To know the occurrence of events and the course of experiences students must interact with the scene. In the meantime, students are required to communicate with classmates and teachers around them. And the best way to communicate is using language. This is where and why the Language-Oriented Approach came in. From the prospect of learning, the main points of the LOA are as follows.

The first point is grasp on the inventor's native language. Since programming and other technologies are imported from foreign countries, it is necessary to use foreign language tools to get the intended meaning of the original authors of the technology. In this way, programming skills and other techniques can be learned accurately. Many students cannot learn to program, largely because they do not accurately grasp the true meaning of the inventor of the technology. In order to master a technology, it is necessary to start learning the original language of the technology, that requires

students to firstly establish a solid foundation of that foreign language.

The second is to monitor the learning targets and identify their fields where the challenge resides. Students need to be able to capture their learning goals when they encounter new knowledge or new tools. These goals are the driving points that motivate them to continue learning and exploring. Only with goal point clear, can students continue to acquire news.

The third is to survey the gap between their ready knowledge and target. Before assimilating knowledge, the gap between their own abilities and target positions should be figured out first. Once students get their starting point and end point in the learning process, they will be conducted to their learning target of knowledge and skills more effectively.

The fourth is to demodulate the knowledge gap into steps to achieve the goal. Starting from the targets, students should see what precursor knowledge we need to achieve the goal, and how successor knowledge are related to their ready knowledge. The relationship between various knowledge and skills are the key points for students to melt the gap and improve themselves.

The fifth is harmony, learning is process for students to challenge their ability to accept and accommodate novices under pressure. In this process, students are always nervous, if they can naturally communicate and exchange idea with classmates, teachers anytime and anywhere, it is very helpful. In a subtle way, the gap between students' knowledge and teachers' will be dissolved.

The sixth is expression. When students integrate new knowledge into their own knowledge system, the learning results do appear. At this time, students need to express their achievements in language and save them as existing knowledge to be reserved.

Under the structural of LOA, a tour of students' learning should include the above nodes. LOA subdivides the student's learning process, which is conducive to the detailed design of the teaching program and its process, so as to improve the teaching effect.

3.3 Cycle of Language Oriented Approach of Science and Technology Teaching

The combination of teacher's points of teaching and student's points of learning, cross-promotes each other, forms into a complete process which is a period of learning and teaching. This process continues, constitute a continuous cycle. There is a feature in this cycle, that one period's outcome can be the other's start. In LOA, the learning process continues. This is a LOA cycle to complete the learning and teaching. Once the study process is complete, one learning cycle is completed, and the cycle can continue. This is different from the Constructivist approach, in LOA, the learning result of the previous cycle is the learning start as a ready knowledge for the next cycle, of which smoothly connection can be done and the cycle continues.

The above is the basic process of Language Oriented Approach. Programming teaching is a special teaching process. For other technical courses in Science and Technology(S&T) the teaching process of is similar, the accuracy requirements are the same, the basic principles are the same. Therefore, this approach can be extended to teaching of other technologies, and also to the teaching of Science courses. So this approach can be generalized to Science and Technology Teaching, called Language Oriented Approach of Science and Technology Teaching (LOA of S&T Teaching).

4. Core Connotations and Distributions of Language Oriented Approach of Science and Technology Teaching

In recent decades, human society has experienced unprecedented technological progress. The development and extensions of new technologies require corresponding updates to educational methods and techniques. The more technology advances, the greater the need for technical education. Meanwhile, Science and Technology education can promote the development of Science and Technology.

In recent years, the adjustment of the professional structure offered by colleges and universities shows that the number of Science and Technology majors has increased rapidly. Science and Technology education has been pushed to the head of the wave of the information revolution. Front-line teachers should make due contributions to the progress of Science and Technology. I have studied the essential attributes of Science and Technology teaching, here are some of the findings, described as follows.

4.1 The Nations and Theoretical Inductions

Language is the first tool in teaching. Learning and teaching is realized in the process of communication between teachers and students. The teaching process is actually the communication process between teachers and students. The principal medium of human communication is language. Language is main tool of communication, effective teaching should strengthen the tool of language,

The accuracy of language expression is the core of Science and Technology teaching. When education mainly focuses on Science and Technology propagation and development, language accuracy is an essential in the teaching process. Compared with others such as Social science, art, S&T has a strict architecture, its concepts have coherence, continuity. You can not jump to, you can not assume. S&T teaching requires the accuracy of communication. Without this accuracy, S&T teaching will fail and students will not gain anything. Language Oriented Approach of Science and Technology Teaching is a teaching method that generated by the pursuit of communication accuracy.

Language communication will be cut into three sections to enhance the efficiency. In the teaching process, there are three kinds of communication activities: communication between teacher and students, student self communication, teacher self communication, the former one is easy to be understood and to be accepted; the latter two are self communication which are hard to understand. In fact, self communication is the reasoning activity in one's heart or brain, self communication is talking to himself or herself repeatedly. Reasoning is a constructive process that involves the use of logical and critical thinking to draw conclusions.

The quality of teaching depends on the state of communication accuracy. According to the quantification of concentration of the semantics delivered by the communication, the communication accuracy can be divided into two kind of state: rigorous and fuzzy. In Science and Technology teaching, we need the rigorous delivery and reasoning to be keep precision but discard fuzzy delivery and reasoning. To ensure the teaching efficiency, the LOA of S&T teaching become a method that pursues rigorous accuracy. The LOA of S&T teaching pursues rigorous accuracy in each communication phases individually. This is the most crucial difference between LOA and the previous use of English textbooks for education. In the process of S&T teaching, the three phase accuracy states must be all rigorous, so to keep the whole communication process, namely the teaching, being rigorous. This necessary condition ensures that the students' learning process is effective, students can gain new knowledge but not fail off. This is the key to successful teaching. Commonly the three phases of communication have been arranged in sequence in the process of teaching. In ordinary, a typical sequence of communication is presented into four stages, that is, teacher self, then teacher and students, then student self, then teacher and students again. These four stages communication are made in succession. Since a cycle of a S&T teaching has four communication stages, each stage has it’s communication accuracy respectively. If the state of accuracy of any stage is fuzzy, the whole communication will fail and the teaching cannot propagate the knowledge or message, the teaching will fail.

Self language reasoning is employed. My study has shown that The communication phases in LOA include special phase category, that is self communication. In self communication, reasoning

can take a great role in learning and teaching. Self Reasoning is an internalization process that is closed within own scope of reasoning entity. Both in students self and teachers self stage, self communication wiil do. Self Reasoning also repeatedly does in previous. Reasoning in teacher self communication promotes the growth and accumulation of teachers' knowledge, and has a generative mechanism of knowledge in teachers' lesson preparation activities, while reasoning in student self communication is the main way to improve their knowledge and ability.

Making an extension from human language to machine language, the concept of Language can be broadly redefined. This new identification has significance for AI application in education. Programming languages are communication tools for software to computer. They also have the reasoning and deduction functions as human language does, but in some computation fields, greatly exceed human language in efficiency. Computer development has entered the age of artificial intelligence, and the operations of machine language are manifested as the uses of AI software.My research has shown that after the teaching communication process is segmented, each phase can be considered to use AI technology or not. When we are not using AI technology, we are executing traditional education; if we are using AI, it is contemporary education. At each phase of communication, AI can be used, and various AI technologies can be used individually in different stages, that is, different AI application technologies can be introduced into teaching at individual stages. This opens up many areas for AI to be applied to teaching, and many opportunities for AI innovation have come.

4.2 The Distributions of Application

Combined these AI applications together with the accuracy requirements of LOA, we arrive at those do not use AI but ensure the accuracy of communication in the three communication phases respectively. The fourth, fifth and sixth methods ensure the accuracy of communication and use AI respectively. See table1.

In fact, my previous practical attempt [2] in LOA of programming teaching which advocates inventor’s native language, belongs to the second method in Table 1. That approach focuses on the design reform of teaching method by using traditional means to ensure the accuracy of teacher-student communication without losing the original meaning of texts or orals.

Table 1: Six distributions of LOA of S&T teaching.

Communication phase / AI Employment	**Teacher self**	**Teacher and students**	**Students self**
no	The first method	The second method	The third method
yes	The fourth method	The fifth method	The sixth method

ChatGPT is now being used in education as a kind of AI software, and it has caused many of impacts. We can see two facts that the application of ChatGPT has. Firstly it reduces the working time of teachers, and secondly it improves the learning efficiency of students, which are welcome results. Analyzing the phenomena of ChatGPT use in education under the LOA structure, we can found that using ChatGPT is an AI application in the phase of teachers' self communication, which fasts the speed of communications and improves efficiency of teachers' self reasoning. This presents the learning target in front of students in a timely manner, rather than waiting for many steps to figure out goal on blackboard in the past, which lets students go tired. This is the secret of applying AI to teaching to save teachers' time and improve students' efficiency.

At present, apart from ChatGPT, there is almost no more AI software available for teaching. However, when analyzed under the LOA structure, we found that AI application software can also be developed in both phase of the teacher-student communication and the student self communication. This is where LOA is really useful that LOA can provide guidance and direction for the application of AI to teaching.

In the three phases of communication, we can examine whether the accuracy of each phase is successful or not, to see which stage is residence of the problem of our teaching quality. In this way, we can find the specific links that have troubles, and further think about how to improve the quality of science and technology teaching. Therefore, the use of this teaching method has a strong practicality and can be put into practice, rather than on paper.

When we take each phase out and deal with it independently, our understanding of the teaching process and the cognition of education will rise to a new higher level. With LOA,we can have a rational analyzing to new teaching challenges, so that we can calmly face the impact of the application of new technology on teaching, and deal with it easily.

The LOA was born as a product to meet the demands that technology development has placed on education. The LOA of Science and Technology teaching is a teaching method adapted to the requirements of the rapid development of technology in the information age. It is different from the previous teaching experience of using English textbooks, which was implemented because the teachers at that time were foreigners who only spoke English, and in which the teaching process was not segmented in the channel of communication in that time.

5. Conclusion

We can improve the teaching quality by designing a curriculum system, such as adding Computational Thinking courses, or we can improve the teaching quality by using Language-Oriented Approach. Comparatively, latter is more effective.

My study shows that the core ideas of LOA of Science and Technology Teaching can be extracted from Language-Oriented Approach of Programming Teaching. In LOA, the teaching process is the language communication process between teachers and students, and the language communication process can be specialized in segments, so the teaching can be designed in detail to the specific communication stages. Communication in science and technology teaching must be accurate to ensure students not fail. On the basis of pursuing accuracy, dividing the phases of communication, I combined the accuracy and the use of AI in LOA, six specific application methods of LOA can be figured out. It’s what my table is.

The troubles in each specific subject education are diversity, and the specific problems in each course we need to solve are different. Corresponding to the language communication phases where the problems are located, needed methods can be applied to implement and improve teaching reform. For programming teaching, the problem we faced is the loss of original meaning in translation, so it is raised from the accuracy of teacher-student communication. Therefore, its solution, the inventor's native language method, belongs to the second method. As for the application of ChatGPT, it solves the problem of the efficiency of teachers' own reasoning in their self-aspect, so it belongs to the fourth method. I believe that other kinds of concrete application methods will be developed gradually. From this perspective, ChatGPT is a concrete application to LOA.

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