Teaching Mode of Internet of Things in Colleges

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Abstract. This paper focuses on education of Internet of Things in colleges. Based on the purpose of higher education in Internet of Things, we put forward a view that Computational Thinking and Problem-based learning are most important parts in the process of training. The curriculum has been discussed and we have proposed that how to carry out teaching method and organization of grouping learning. Through these measures, students will acquire the most important ability of learning and lay a good foundation for their future career.

Introduction

The Development of the IoT

The Internet of Things (IoT) is the inter-networking of physical devices, vehicles, buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to collect and exchange data.[1] In short, The IoT remotely detects or controls objects across existing network infrastructures, integrating the physical world more directly into computer-based system. According to Gartner, Inc., there will be nearly 20.8 billion devices on the Internet of things by 2020. As such, it is clear that the IoT will consist of a very large number of devices being connected to the Internet.[2]

IoT products can be classified broadly into five different categories: smart wearable, smart home, smart city, smart environment, and smart enterprise. Other applications that the IoT can provide are intelligent shopping systems, energy management and cruise-assisting transportation systems and so on. The concept of an "Internet of living things" has been proposed networks of biological sensors that could use cloud-based analyses to study DNA or other molecules.[3]

In order to adapt to the rapid development of the IoT, many colleges and universities have set up related majors and cultivating talents of the IoT has become a compelling topic.

Higher Education and IoT

The purpose of teaching in colleges and universities is to cultivate generalist than specialist. This concept meets not only the social requirements in the ear of rapid development of technology, but also the aim of training of senior staff and the needs of student's self-promotion. However, in the case of student quality decline and employment pressure by the expansion of enrollment, this training model has been questioned by many educators. And for the IoT, these problems seem more urgent.

Firstly, students must learn a lot of basic theories which involve wide ranges, such as algorithms, programming, hardware, communications, embedded development environments, and sensing technologies. So how to choose proper courses to learn in a limited time is an important thing.

Secondly, technology of the IoT develops rapidly. This requires students to learn lots of the courses. To face the demand for talent market, how we can choose most appropriate courses to make students get better employment opportunities is also key point we must think about.

In recent years, various training institutions of the IoT draw up a large number of curriculum plans. Many students have finished these courses and found nice jobs. However, there are many differences between vocational and undergraduate education. So whether these curriculum plans is suitable for universities and colleges is still a problem.

In this paper, we focus on discussing which method is better for Education of the IoT in universities and colleges. A teaching mode of IoT has been proposed based on cognitive level of students, the teachers' ability of teaching, the equipment in school, social needs and so on. In this mode, Computing thinking and Problem-based learning play very important roles. Most of all, for improving efficiency, Group Learning and Collaborative Learning have become important elements.

Computational Thinking in IoT Learning

What is Computational Thinking

As Wing. Jeannette put forward, Computational Thinking is the thought processes involved in formulating a problem and expressing its solution(s) in such a way that a computer—human or machine—can effectively carry out.[4] Informally, Computational Thinking describes the mental activity in formulating a problem to admit a computational solution. People can learn Computational Thinking without a machine and Computational Thinking is not just about problem solving, but also about problem formulation. Simply put, programming tells a computer what to do and how to do it.

Computational Thinking requires the following four basic techniques:[5]

Decomposition involves breaking down a complex problem or system into smaller parts that are more manageable and easier to understand. The smaller parts can then be examined and solved, or designed individually, as they are simpler to work with.

Pattern recognition involves finding the similarities or patterns among small, decomposed problems that can help us solve more complex problems more efficiently. Patterns exist among different problems and within individual problems. We need to look for both.

Abstraction is the core of Computational Thinking. [7] Abstraction is used to define patterns that are promoted and parameterized from specific instances. It captures the common properties of a set of objects while ignoring the irrelevant differences among them.

Algorithm is effective method that can be expressed within a finite amount of space and time and in a well-defined formal language for calculating a function.[8]

Computational Thinking----A Core of IoT Design

Just as we know, the development platform upgrades very quickly. Even if we pay attention to specific development methods on these platforms, there is still no guarantee that students will be able to use them for a long time. The applications of the IoT are very practical, but during the development life cycle, the core requirements for developers are still several of the abilities mentioned earlier. By contrast, if students have Computational Thinking and a solid foundation, they can learn specific operations in a short time and the development platform will not be an obstacle.

The courses related to the IoT can be divided into three levels, about hardware implementation, software design and requirement of applications. The hardware implementation layer includes embedded processor, hardware communication and sensor, etc. They achieve instructions from software design layer through the hardware facilities. The software design layer achieves the algorithms which complete the requirement of applications. All these courses involved in task decomposition, modeling expression, coding and other common problems.

The development process of the IoT system is the transformation of the expression at different levels of the algorithm. Designers of IoT firstly think that how to find a practical calculation model. For upgrading an application of IoT, we have to translate a language from one to another. It will be easily when people own Computational Thinking. So, in the face of ever-changing technical means, computing thinking is the basis for students to engage in professional work and lifelong learning for a long time. Therefore, Computational Thinking is the primary goal of teaching work.

Problem-based Learning in IoT

Problem-Based Learning

Problem-Based Learning (PBL) is a student-centered approach by which students get relevant experience by solving open-ended problems found in triggering materials. During studying of course, what we focus on is not the solution of specific problems, but to obtain the skills and attributes which students need through completing of these problems.

These skills and attributes include knowledge acquisition, group collaboration and communication. The process allows for learners to develop skills for their future practice. PBL may position students to solve problems easily by observing and comprehending the experience of the real-world. [9]

Collaborative Learning

PBL requires students to cooperate with each other in the process of learning, which requires the introduction of Collaborative Learning, thus forming a complete learning environment to achieve the desired results.

Collaborative Learning is a way of learning that two or more people study together.[10] Unlike individual learning, people who collaborate can share resources and skills.[11][12] This learning mean, which is based on the interpretation of learning that knowledge can be created by members in the condition where people can share experiences and take on asymmetry roles. In other words, learners participate in a common task, and everyone relies on each other and helps each other.[13]

Group Learning

PBL is particularly dependent on Group Learning. [17] Yew, and Schmidt, and Hung elaborate on the cognitive constructivist process of PBL: [18]

(1) By the discussion in the group, the learners understand the problems they face and activate their prior knowledge.

(2) In their team, they work together to determine what problems will be study and develop possible theories or hypotheses to explain these problems. Tutors play an important role because they provide some possible frameworks where students can construct knowledge relating to the problem.

(3) Students work independently to research the issues after the initial team cooperation.

(4) At last, the students re-group and discuss such issues again based on their new acquisitions.

Problem-based Learning and IoT

The design of IoT related to network communications, embedded systems, computer software, large data processing, intelligent systems, sensing technology and other fields. These courses are numerous and jumbled, and if they can be integrated by special applications, it will improve the efficiency of learning and students may have a deeper understanding of their nature. PBL provides a very effective solution to this problem.

Collaborative Learning is an effective way to study autonomously. Students can effectively exchange learning results, solve problems together, propose learning programs, check learning progress, and track advanced technology.

Through reasonable grouping, students can learn from each other. Learning in the group is also conducive to the improvement of students' communication ability. The communication ability can be acquired by Group Learning and will be beneficial to make student's practical work in the future.

A Teaching Mode in IoT

The Curriculum of IoT

In the professional teaching plan and course setting of IoT, we should give full consideration to how to achieve the goal of Computational Thinking in the problem-based learning mode. For this purpose, our curriculum of the IoT is divided into the following three modules:

General Engineering Knowledge Courses. (GEKC) are to enable students to have broad knowledge, strong Learning ability, ability of algorithm design and good scientific literacy. GEKC is not only to enable students to have a broad common software and hardware knowledge, but also ability to adapt to work, good natural science literacy, and a comprehensive ability.

Basic Theory Courses of IoT. (BTCIoT) is to make the students have a solid theoretical level of computer modeling ability and the engineering ability. The key of this module is to make students have Computational Thinking. So it is necessary to redefine the teaching objectives of these courses. We can change the decentralized independent curriculum into a whole system that is closely linked and the final goal is to make students solve problem by Computational Thinking.

Application Course of IoT(ACIoT). is to make students have ability to take part of designing application system. In order to achieve the goal, we must select carefully the appropriate cases and improve the existing teaching and experimental materials.

Reform for COMPUTATIONAL Thinking and PBL

The Reform of Course Content. For achieving goals above, we need reorganize the course modules and reconstruct the course content. Students need following abilities to establish good Computational Thinking and have better system design skills.

1. Mathematical modeling;
2. Algorithm analysis and implementation;
3. Understanding the development environment;
4. Engineering development skills under the guidance of engineering ideas.

This work is at the core of the whole reform. So each course must be redesigned and reorganized according to this requirement. We need to develop practical examples suitable for Group Learning and establish platform for Collaborative Learning.

The Reform of Collaborative Learning. Obviously, students who study with their peers are much more active than their own learning. The atmosphere created by communication helps to students learning. In addition, students can help themselves and their peers through cooperative activities. Because of the intense interaction between students, this is more effective than independent study.

Compared with the individual learning, Collaborative Learning is beneficial to improve students' interest in learning, promote the concentration and excitement in the collision of thought and enhance the learning efficiency. Collaborative Learning can also improve students' self-learning ability, change passive learning habits, and become active participants and mentors of learning process. In the designing of the IoT, students should have good cooperation ability and Collaborative Learning is particularly important for achieving this goal.

Organization of Group Learning. For , organization of Group Learning, there are several factors as follow we must consider

(1)The number of each group

In general, we may make some small groups when course is easy; Students in group should be familiar with and to communicate easily, so if the team members are not familiar enough, we should reduce the size of the group to facilitate communication; If the task is not large, the group should be smaller than usual; If the enthusiasm of students to participate is not high, the size of the group should not be too large; The stronger the members, the smaller the group size should be.

(2)The role of group members

The team leader is responsible for coordinating the learning tasks of the members in group, making fixed learning and communication mechanism. All students need to report their own learning situation, show their own learning outcomes.

(3)The principle of grouping

Each group member has his or her own characteristics. In such group, the division of task may become an easy job. In essence, the level of each group should be about the same. If the part of

students lack of learning motivation or self-learning ability, we ought to make an effective mechanism that teachers can track the situation of each student and can intervene in the learning process.

(4)The exchange and presentation between the various groups

It is very important to ensure that under the guidance of teachers, the various groups can demonstrate their results of learning so as to achieve the purpose of communication between groups and mutual learning.

Conclusion

In China, it is no long ago when colleges and universities begin to set up majors of IoT. So the method of personnel training is still exploring.

We put forward the characteristics of higher education from the perspective of the whole IoT industry and discuss a teaching mode in which calculating thinking is considered to be the most important ability of the students and PBL is used. Meanwhile, Group Learning and Collaborative Learning play important roles in the method. We also put forward the basic principles of choosing curriculum, the measure of Group Learning and the means to improve the content of the courses.

It is a key thing to realize that in this ever-changing background, any traditional classical teaching ideas and methods should be re-examined, and the new teaching model and disruptive teaching philosophy is also worthy of attention and thought.

We believe that with the continuous deepening of the teaching process, people will have a more in-depth understanding on education of IoT.

Acknowledgement

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