Research on teaching mode of applied curricular reform based on ADI

-- Example of principles and application of MCU course

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Abstract. In order to overcoming the shortcomings of local applied curricular teaching mode, the reform of applied curricular system is proposed, which is based on ADI (Argument Driven Inquiry) teaching mode. The concept, theory and implementation process of applied curricular teaching mode is explored in this paper, which is based on the course of the principles and application of MCU. The teaching reform aims to strengthen students' practical application ability, and cultivating students' basic knowledge and skills, moreover to keep focus on the importance of scientific thinking. At the same time, we propose methods for improving of teachers' professional abilities in application-oriented schools, and provide reference experience for the promotion of application-oriented courses based on ADI teaching mode.

Keywords: ADI; Applied Curriculum; Teaching Reform; MCU.

1. Introduction

At present, the local application-oriented curriculum reform is carried out in CHUXIONG Normal University. According to document "Guidance on local ordinary undergraduate colleges and universities to application-oriented transformation" instruction, which is issued by the Ministry of Education of P.R.C. The ideas of “oriented to Yunnan province based on CHUXIONG area” application-oriented curricular construction is fulfilling by CHUXIONG Normal University through integrating of the two education methods, which are innovation and entrepreneurship education and professional education, and the students' two abilities would be promoted, which are professional skills and innovation and entrepreneurship abilities.

In recent years, lots of scholars have made many explorations on the applied reform on both of talent training programs and course teaching systems. For examples, Xiaojie Tang et al. have adopted virtual simulation technology to carry out teaching reform for MCU (Micro Controller Unit) course for achieving teaching objectives in 2020[1]. Haiyan Song et al. discussed the relationship between C language and single-chip teaching methods in 2021,for stimulating students' learning enthusiasm[2].In 2021, Yucun Wang put forward the education model of combining ideological education and classroom teaching by taking the principle course of MCU, to achieve the goal of talent training[3];Wai Cui used the internet technology for reforming the teaching of MCU course in 2017, and made some exploration in the aspects of experimental practice and examination form[4];In 2020, Chen Meikun et al. had carried out teaching reform in MCU course with maker project-based teaching method[5];In 2020, Sun Zhiqiang proposed the reform of "curriculum, ideology and politics" from the educational system of application-oriented colleges for achieving the purpose of improving the educational system[6];In 2021, Guo Yu, Wang Chenning, Tang Fei et al. carried out teaching reform from the aspects of curricular experimental design, teaching methods and assessment, and explored the training mode of application-oriented innovative talents[7].

The reform methods, which proposed by the above scholars, have positive effects on reform of talent training programs and curricular system, however, there are defects in the transformation of application-oriented colleage. In application-oriented undergraduate education, the emphasis of curricular reform is a combination of cultivating learners' practical and innovative ability, which could integrate organically the innovative and entrepreneurial ability at the same time, so that learners

are cultivated into interdisciplinary talents who are able to work in both information technology and scientific research.

The shortcomings of existing local applied curricular teaching reform are discussed in this paper, which combined with the experimental platform and advantages of MCU principle and application course in the School of Physics and Electronic Science of CHUXIONG Normal University. The curricular reform based on ADI teaching mode is proposed in this paper, and the training mode of applied talents are explored in local universities.

2. Analysis of current situation and problems of local Application oriented course

At present, CHUXIONG Normal University actively carries out the construction of application-oriented courses according to the relevant measures of local colleges and universities in application-oriented running. The principle and application course of MCU has been carried out as a pilot unit .It is great significance to cultivate students' practical application ability and good scientific analysis ability through MCU course, but traditional teaching methods and assessment solution don't meet application-oriented undergraduate education goal. We investigate the teaching process and teaching effect in the major of electrical engineering and automation in recent years, what problems we found in the construction of this course show as follows:

(1) lack of student professional foundation.

Taking the principle and application of MCU course as an example, learners are requested to master method of electronic circuit design and fundamental programming theories, whose ability is based on course of analog circuit, digital circuit and C language programming. Comparing with admission lines in major of electrical engineering and automation of CHUXIONG normal University in recent five years, there is a rising trend year by year, however, it can be seen that students' application ability of basic, practical application show a slow downward one according to the surveys of teaching situation.

(2) Curricular training plan setting didn't match with and application-oriented talent training objectives. By comparing teaching hours of MCU course, which one belong to major of electrical engineering and automation and another belong to major of electronic information science and technology, it is found that the former training plan is 36 credit hours for theory and experiment, but latter's is only 18 credit hours for the experiment, although the course total hours both are 72 credit hours. In the critical period of local university's transformation into an application-oriented undergraduate university, application-oriented talent training emphasizes the cultivation and assessment of practical ability, but the current training plan and the existing reform direction appear inconsistent problems for courses just as MCU.

(3) The course assessment method does not meet the assessment demands of applied talents.

Taking course of principle and application of MCU as an example, the final assessment has been accounted for 40% than 60% as a comprehensive performance before curricular reform is carried out, which is lack of assessment on students' practical application ability, and can't evaluate 4 goals (knowledge, ability and accomplishment, thought) in Application oriented course. The traditional assessment method could not effectively assess the students' micro-control circuit module and basic programming ability in the course. According to the surveys of students' satisfaction with assessment method before curricular reform of MCU principle and application course, it is found that the traditional assessment method is difficult to motivate students' practical application ability and could not improve the willingness to participate in the corresponding discipline competition.

3. Practical exploration of ADI teaching mode

3.1 The fundamental of ADI teaching model

At present, traditional applied courses focus mostly on the learner's mastery of experimental operation and skills, which could weaken their scientific theory learning and demonstration methods in the experimental design of applied courses. Professor Sampson put forward ADI(Argument-Driven Inquiry) teaching model based on argument-driven teaching strategy in 2011[8,9].This teaching model could be in accord with the basic concept of the applied undergraduate university in China, which is divided into 3 stages and a total of 8 teaching links in this paper, and it is put forward in this paper which is shown in figure 1.

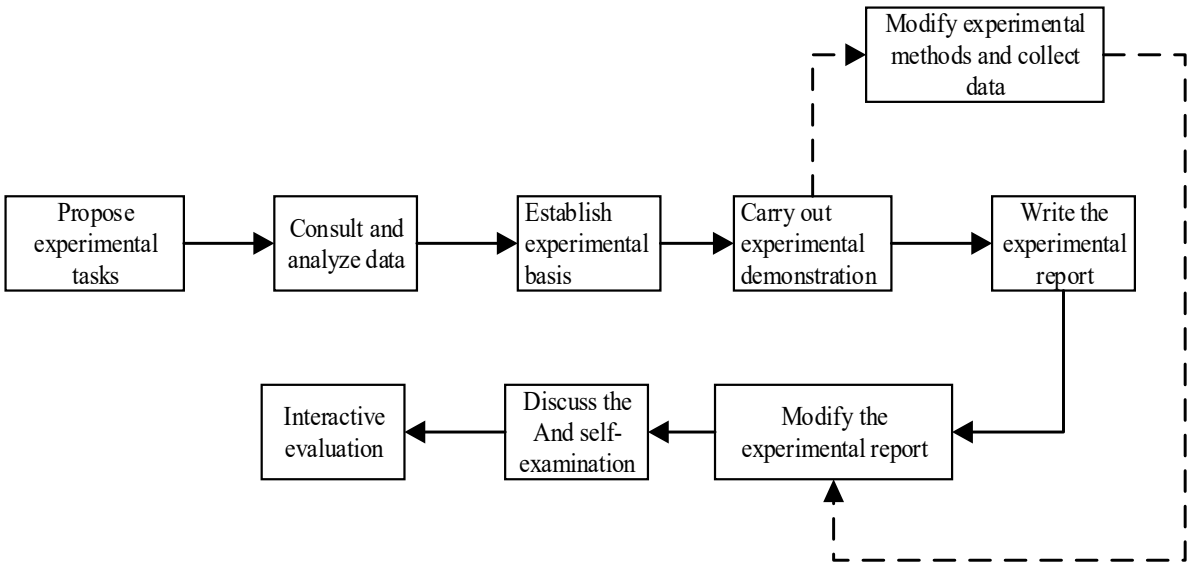

Fig.1 Teaching links based on ADI of MCU principle and application course

3.2 Reform of examination method based on ADI mode

The traditional examination method was adopted in the midterm and final examination scores, which could assess the mastery degree of each chapter. After introduced the teaching model based on ADI, The kind of reform ,as mentioned in the previous section, in MCU principle and application course has been put forward in CHUXIONG Normal University since 2020, as shown in Table 1,the examination adjustment ideas are to increase the proportion of assessment of students' practical ability and students' mastery of basic knowledge, more important in ones of basic application ability and comprehensive ability of the subject. The midterm examination is tested online on special learning platform instead of traditional paper papers, which focus on the ADI comprehensive project adopted in class by the course team. In addition to testing students' basic knowledge and theories of the whole semester, the final examination is tested more students' practical and comprehensive ability. Taking the course of MCU principle and application as an example, the average score of students' paper scores increased by about 10% after the reform, and from the perspective of the subsequent comprehensive projects, the comprehensive design ability of students was effectively improved, and the logic programming ability and teamwork of students were further strengthened, which was more consistent with the educational goals of local application-oriented undergraduate students and could provide reference for other application-oriented courses.

The assessment reform of experimental performance is a comprehensive performance examination of demonstration, group discussion and interactive evaluation after students carefully listen to teachers' guidance of experimental requirements, key points, difficulties and matters needing attention of experimental projects. The specific reform projects and scoring standards are shown in Table 2.

Table 1. Comparison table of evaluation mode of MCU principle and application course

Reform states	examination item	ratio	contents of examination
before	usual performance	30%	Student attendance, offline work
	Midterm examination score	10%	Midterm Paper score
	final examination	60%	Final papers score with emphasis on theoretical examination
after	Class performance	15%	Student attendance, online and offline work
	Experimental performance	15%	Experimental performance and report
	midterm examination score	10%	Online Test scores
	final examination	60%	Focus on practical application of the final examination paper scores

Table 2. Scoring standard for single experiment performance

Experimental performance section	standard for evaluation	Score ratio
Experimental demonstration	The mastery extent of basic experiment concept ,and solution is whether reasonable and feasible, which meets the software and hardware programming requirements of the course.	20% from teacher ratings
Course group discussion	Putting forward different solutions, participate actively in group discussion and class communication;Demonstrating fully the results of the discussion, answer fluently the questions of teachers and other group students with clear basic concepts, logic and reasonable solutions.	20% from teacher ratings
Experimental interaction evaluation	The group members will show the effect of the experimental project, and will be judged by other groups to achieve all the scoring points which good experimental effect will be 100 points, the other degree of score is judged accord to the extend of fulfilling how many the experiment goals .	the average account for 50% from scoring by other groups

4. The enlightenment and reflection of ADI teaching mode on the principle and application teaching of MCU

Teachers are emancipated from the cycle of dogmatic experiment explication, demonstration - and summary with ADI teaching mode. Before class beginning, teachers pre-evaluate the experimental plan of each group, and encourage students to design actively the experiment without violating the original intention of the experiment, and verified its scientific and feasibility of the experimental principle through group discussion. The enlightenment of ADI teaching mode adopted to teachers mainly includes the following points:

4.1 ADI teaching mode is consistent with core literacy of MCU course

Taking the A/D conversion experiment of MCU course as an example, we lay emphasis on cross-type teaching mode which could explore the mathematical relationship between digital and analog signal that is an important topic of this experiment. The concept of cross and interactive study are learned between disciplines in the application of MCU programming with the ADI teaching method which is taken example as: the principle of two kinds of signal (digital, analog) conversion and the chip interface and programming (single-chip serial interface with A/D conversion chip).The concept of interactive learning and practice in MCU course is applied more, which could be found in our teaching materials of MCU course, for training students' comprehensive application programming

ability that is consistent with their core accomplishment cultivated.The knowledge system of MCU course is built with ADI teaching mode which is conducive to reforming its basic concepts which could be utilized for programming language to build the logical relationship between software and hardware .For example, the architecture and functions of interface ,the relationship between MCU interface technology , etc. Furthermore, the ADI teaching model that enables students to gradually develop the core concepts of the applied-oriented course in the process of exploration and practice.

4.2 Improve students' scientific writing ability

In the traditional application-oriented course teaching, its objective focuses on the cultivation of students' practical application ability, which weakens the cultivation of students' scientific writing ability [10]. With ADI teaching mode, we pay more attention to urge students to read experimental materials and references before writing experimental reports. Experimental demonstration is added in the experiment process, which is conducive to the design and verification of experiments.

In the stage of experimental demonstration and communication, the students clarified the logical thought contained in the experiment through oral debate in the form of a group, which is guided students to use the basic knowledge of the subject for academic communication in the process of debate by teachers, which is benefit for training of students scientific writing lately .In the later stage of the experiment, the experimental data would be collected and processed, and the scientific argumentation thinking would be summarized in the debate stage. In the end, the experimental report could be revised and the article could be polished by the guidance of the teacher, that would be submitted as an academic paper. The ADI teaching mode meets the demand of modern application-oriented undergraduate universities for talent training, we summary as “one major for multiple skills”, and it is available for experimental results conversion, and improving the enthusiasm of students to participate in the experiment.

4.3 Application-oriented curricular development guided by teachers

In the ADI teaching model, teachers play a leading role in the teaching activities, and students participate as experimental designers in the process of application practice. The teaching activities divide into several progressive stages are carried out. Taking the course "Principle and Application of MCU" as an example.

Firstly, reasonable teaching plans are made with the ADI teaching process by teachers who should explain the key points and difficulties in classroom teaching to students according to the teachers' rich curricular theories and practical experience, and prepare experimental stuffs in the early stage according to the characteristics of ADI teaching mode.

Secondly, the cultivation of students' scientific logic programming ability is paid more attention in teaching, rather than the traditional verification of experimental ability, for reserving knowledge of software and hardware and cultivating application-oriented practical abilities in the experimental process. During the experiment processing, the teacher guided consciously the students to program boldly and verify their experimental ideas of each group. The basis for determining the teaching effectiveness are experimental process assessment instead of traditional results-only theory.

Finally, we found that the students' application ability of long-term development demand of ADI teaching experimental design and interactive evaluation should be applied more leading role instead of experimental results. Furthermore, teachers, who participated in teaching course of MCU, attach importance to cultivate students’ dynamic thinking and static observation study habits that could help them to master method of scientific verification in the process of achieving experimental objectives.

5. Significance of promoting the ADI teaching model in application-oriented courses

With ADI teaching mode ,the course of "Principle and Application of MCU" has been effectively carried out through our teaching team in CHUXIONG Normal University as a representative

application-oriented course at present .After adopting ADI teaching mode, the average score of students in our course has been increased by nearly 10 points compared with that of the previous academic year, furthermore, the numbers of subject competition awards which is related to MCU course have also been significantly increased about 20%.For popularizing the ADI teaching model, our curricular team concluded the following meanings:

Firstly, it could improve greatly the practical application ability of teachers with ADI teaching model. It is necessary for the teachers adapting ADI teaching mode who would have abundant reserve of professional relevant knowledge of subject, and professional evaluation ability of experimental phenomena and conclusions designed by students. Adapting ADI teaching mode requires teachers to have a solid reserve of professional knowledge of the subject, and professional evaluation ability of the experimental phenomena and conclusions designed by students, and rigorous logical thinking in the stages of experimental verification and discussion. During the teaching process, teachers abandoned the traditional cramming education and returned to the original intention of application-oriented curriculum which is practical teaching with ADI teaching model.

Secondly, scientific research ability could be enhanced the scientific research ability for both teachers and students. Students are required to participate in the experiment design and development with ADI teaching model, and attended in the processes of experimental data acquired, sorted and reprocessed, for attaching more importance to experimental teaching of design and interactive discussion of argument, whose experimental report could be writing as academic papers. therefore, academic and scientific research ability of them could be promoted by adapting ADI teaching model.

Finally, it could inspire participants' spirit of teamwork and innovation. During ADI teaching process, students work in groups who would be guided by teachers. In the teaching process, students are both participants and designers whose discussion and communication in practice stages can not only highlight students' personalized design ideas, but also condense the collective wisdom of teamwork. Moreover, the experimental results of output efficiency could be promoted by team cooperation way that also can produce the innovative thinking such as brainstorming. Therefore, the output of application-oriented course target is no longer limited to experimental results which is paid more attention to research results, so that students' knowledge system is adjusted to update actively instead of motivating them from passive learning status that could encourage teachers and students to improve practical application ability.

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