Application-oriented Three-dimensional Training Mode for the Limits and Fits Curriculum of Mechanical Engineering

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Abstract. Limits and fits curriculum is an important basic course in major of mechanical engineering. This course is also the fundamentally professional ability to solve the engineering and technical problems after students graduate to work. However, there exists the disorganized course system for limits and fits curriculum in some universities. The related courses is chaos in hierarchy, logicality and time-efficiency. Thus, the teaching contents cannot be formed the systematic and application-oriented training mode in the limits and fits curriculum. In view the strong engineering application background for the course, we propose an engineering application oriented three-dimensional training mode for limits and fits curriculum. The aim is to improve the theoretical and the applicated ability of students for this curriculum.

Introduction

Limits and fits curriculum, the same as the mechanical principle and mechanical design, is the one of three basic courses of design in mechanical specialty. This curriculum is also an important professional basic course for bachelor degree in engineering. The limits and fits curriculum is like the bridge to connect the courses of the mechanical design and the mechanical manufacture. It is related with a lot of areas that are product design, manufacture, inspection and measurement, and manufacturing management. However, the limits and fits curriculum exists in some features that are easy results in unacceptable performance for students’ study.

Problems of the Limits and Fits Curriculum

This course includes many terminologies, standards, notational concepts and symbol codes, which is related with lots of areas. Traditional teaching modes that remember concept and formulas and teach practice questions are not useful to train the ability and awareness of students for the limits and fits curriculum [1]. It is easy to result in boring course, low enthusiasm of the students in class and low harvest rate for knowledge. These series disadvantages produce the high error rate of the limits and fits curriculum in graduation design stage and the poor ability for engineering application.

Therefore, the teaching methods of the micro-course online video and the inverted classroom can be adopted to improve the effect of the limits and fits curriculum [2]. These measures can attract the students’ attention and arouse interests of students for the course. However, the mode of the inverted classroom needs active learning and independent study for the students, no matter the students watch micro-videos before class or finish homework in class. This requirement is opposite with the features of the limits and fits curriculum that are wide knowledge, more concepts and boring knowledge.

Applicability and practicality is the final aim that the limits and fits curriculum is trained for students. Along with the transformation of professional training mode into the mode of applicational technique training, operational ability and manipulative ability are more enhanced in this course [3]. However, the course has so many teaching contents and relates on lots of knowledges, the more key problem is that the class hours is less. How to complete theoretical teaching and experimental exercise in limited class hours is the confused problem. On the other hand, the mechanical parts
drawing need various knowledges that are mechanical drawing, engineering materials and heat treatment, interchangeability, mechanical principles, mechanical elements design and mechanical manufacture. These relevant contents are appearing in different courses. These courses are distributed in various semesters. Thus, the students generally cannot understand the relation and the relevance of these courses in their study.

Application-oriented Three-dimensional Training Mode

The problems that we have analyzed the limits and fits curriculum above are separately boring contents, poor autonomously studying ability and disordered curriculum system. Due to the importance of the limits and fits curriculum in mechanical subject, we propose application-oriented three-dimensional training mode for this course. The training mode includes several courses that are all related with each other. These courses respectively are the limits and fits curriculum, the mechanical drawing, the metalworking practice, the experiment operation, the course design, the machinery parts designing and processing. All of these courses will be arranged a scientific system to improve the poor application ability of the students in mechanical engineering practice, especially, to improve the bad performance on the application of the limits and fits curriculum[4]. Any one course is an important link in the training mode. The aim of the proposed training mode is to promote the hierarchy, time-efficiency and applicability for the limits and fits curriculum.

The three-dimensional training mode for the limits and fits curriculum is mainly reflected in relevance, hierarchy and time-efficiency of the overall arrangement of the related courses. This arrangement should be application-oriented mode that the final stage of the arranged courses system is terminated with the design and manufacture of the mechanical parts. Of course, the product designed or manufactured by students should be acceptable product, then the students can get the deserved score of study. The purpose of the proposed training mode is to cultivate the students’ ability of the correct tolerance dimension in mechanical drawing. It is also to improve the economical efficiency of the product manufacturing. The first level of the three-dimensional training mode is the basic theory study. The limits and fits curriculum should be matched up with the mechanical drawing course, which are all fundamental theory. The second level of the three-dimensional training mode is metalworking practice and experimental operation, which can bend the knowledge of the theory study with these practices and operation exercises. The last level of the three-dimensional training mode that is the course design and the machine parts processing is the most important link in the application training mode. In the first two stages, theory and practice experience are accumulated for the third stage that the students design and manufacture machine parts. The whole stage can examine the effectiveness of the proposed application-oriented three-dimensional training mode.

Relevance of the Limits and Fits Curriculum Systems

Application ability cultivation in university is a complex system, which is also the purpose of the talent training for higher learning institution. The talent training aim of the limits and fits curriculum is reflected on feasibility, economical efficiency and perfectness in the process of mechanical design and manufacturing. The designed products satisfy the general production requirements, which can earn economic effect.

In a general way, this ideal consequence of application-oriented training mode need to be supported by several kinds of knowledge. The single course of the limits and fits curriculum is impossible to achieve the effectiveness that the students complete an acceptable design independently. Therefore, several courses related with the limits and fits curriculum are needed to support the application training mode. Furtherly, these courses should be scientifically and systematically arranged, which is reflected in relevance of the courses. The limits and fits curriculum and the mechanical drawing course are closely related with each other. The two courses are mainly taught by theory form. Of course, the advanced technique of computer simulation drawing may be arranged in these two courses. After the students complete the theoretical learning, the systematic practice training should be scheduled. Thus, the course experimental operation and the metalworking practice are selected for next stage of students’ learning. This stage includes the practice on machine
manufacturing, the importance of which is the first stage of theory learning connected with these practice courses. The final sage is the course design and the mechanical part design, which is real application for creating products by using the theoretical and practice learning knowledge in the first two stages. The purpose of this stage is to verify the application-oriented training effect for limits and fits curriculum.

Hierarchy and Time-efficiency of the Limits and Fits Curriculum

There are many learning contents that students need study on the limits and fits curriculum. The contents include the concept of interchangeability, preferred numbers, terms and definitions of limits and fits, national standard, annotation method of geometric tolerances, tolerance principles and so on. Especially, more important knowledges are precision design of the typical mechanical parts that contains antifriction bearing, multiple spline, circular cone, screw-thread and cylindrical gear. Of course, the latter is directly related with application of the limits and fits curriculum.

So many contents need students to be learn, and these knowledges are all vapid and dull. This adverse condition is easily cause the impaired concentration for the students in their learning process. Furtherly, the students’ interest in the limits and fits curriculum will be lost. Thus the knowledges of this course need a scientific arrangement that can enhance the students’ interest. Then the knowledge training mode of the multi- hierarchy and the time-efficiency are needed for the limits and fits curriculum. The concept of multi- hierarchy is the logicality and the graduality of knowledges for the arrangement of the various courses related with the limits and fits curriculum in the students cultivation process. This measure is to solve the problem that the current training mode is unable to form the knowledge network of the limits and fits curriculum for students because of the dispersed course system. It is also to improve the phenomenon of learning interest decline. The notion of the time-efficiency is the concentration ratio and the time-sequence that the various courses related with the limits and fits curriculum are scheduled in the students’ teaching and training process. This measure settles the students’ learning problem that the knowledges cannot be remembered deeply and be forgot soon because of the long duration teaching for the various courses related with the limits and fits curriculum. It is truth that students are easy to lose the newly studied knowledges if the interval time of the studying is too long for the different related courses. This condition will easily induce learning difficulty for the students, then they will lose the interests in studying. Therefore, the multi- hierarchy and the time-efficiency is necessary to solve the above problems, compared with the traditional teaching of pure theory and experiment mode.

Summary

According to the problems of the limits and fits curriculum that contents are much boring, high standards in autonomous learning ability of students are required for the micro-course online video and the inverted classroom, and the related course system is scatter, we proposed the application-oriented three-dimensional training mode. The features of this training mode are list as following:

1) Solving the problems of students that the learned knowledges for the limits and fits curriculum are poor applied in mechanical practice, and improving the application, the hierarchy and the time-efficiency of the courses system of the limits and fits curriculum.
2) Keeping the training mode of the students for the limits and fits curriculum on the inherent engineering application pathway, and ameliorating the traditional training mode that is only single theory and experiment courses for the limits and fits curriculum.
3) Promoting the hierarchy and the time-efficiency of the training mode for the limits and fits curriculum, enhancing the learning ability of subjective initiative and the studying interests of the students.
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