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Teaching Reform on Courses and Direction of Undergraduate Thesis for Training of Applied Talents

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Abstract

Under the background of "cultivating internationalized and inter-disciplinary talents for students" in China, it is urgent for local colleges and universities to cultivate the students adapting to economic and social needs. The undergraduate thesis is one of the most important specialized courses in colleges and universities before graduation. It was set up in the seventh semester in Zhejiang International Studies University (ZISU); and we have tried to implement a training mode of applied talents, which focused on cultivating core professional abilities, building characterized teaching contents, enriching assessment systems, and combining production, teaching and research together. Several courses were conducted serving for the undergraduate thesis, such as "Literature Reading and Paper Writing", incorporating the paper translation part into the teaching contents, which is one of the components for undergraduate thesis. Presentation, group work (talking about the reference related to the BA thesis, find the research problem and figure out the creative point of the paper), and discussion are also designed in the class procedure. The titles for undergraduate thesis were selected according to the requirements of working agencies. Meanwhile, academic database such as "Web of Science" was recommended for retrieval of updated articles to ensure the students keep track of the dynamic of the industry.

Keywords: Teaching reform, undergraduate thesis, applied talents.

1. Introduction

"Cultivating internationalized and inter-disciplinary talents for students" is the long term goal of Zhejiang International Studies University (ZISU) [1]. Inter-disciplinary talents refer to students taking advantages of the objective laws to gain benefits for human beings, mastering the professional skills for social activities and social production, converting the universal natural law to direct achievement, building bridge for theory and practice [2]. Under the background of "Innovation and Entrepreneurship", how to cultivate applied talents to adapt to the requirements of the economic society has been a dilemma for local colleges and Universities. We have tried to implement a training mode of applied talents, which focused on cultivating core professional abilities, building characterized teaching contents, enriching assessment systems, and combining production, teaching and research together.

The Applied Chemistry major existed as a traditional specialty in ZISU, based on the development planning of the foreign languages university, it is urgent to seek for a suitable way to survive [1]. An attempt on characteristic development of science specialty in foreign languages and foreign trade university was tried, to practice to cultivate students with both foreign languages skills and also professional knowledge in chemistry. The major direction was divided into two parts: foreign trade of

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chemical products and commodity inspection.

The titles for undergraduate thesis were selected according to the requirements of working agencies, several courses were conducted serving for the undergraduate thesis, such as “Literature reading and paper writing”, “Food analysis”, “Pharmaceuticals analysis”, “Separation and analysis”, “Fabric dying and detection” and “Daily-use chemicals detection” for “commodity inspection” direction; and “Import-export commodity testing practice”, “International marketing”, “Business letters”, “Principles and practice of international trade”, “International business law”, “Business manners”, “International business negotiation”, “Business management”, “Introduction to Ecommerce” for “foreign trade of chemical products” direction.

Table 1. Topic for students of “commodity inspection” direction

Year	Topic
2018	Analysis and determination of organochlorine pesticide residues in agricultural products
2018	Analysis and determination of trace elements in agricultural products
2018	Summary of distribution and determination methods of pesticide residues in tea
2018	Analysis and determination of trace elements in Chinese herbal medicine
2018	Summary of determination methods for stimulant
2018	Preparation of lanthanum-doped Nano-Zinc Oxide and photocatalytic degradation on organic dye wastewater
2018	Advances in the application of nondestructive testing technology in food analysis
2018	Research progress on detection methods of heavy metals in fruits and vegetables
2018	Determination of trace pesticide residues in forest products by nano-TiO_2 enriched-chromatography
2018	The quality and detection method of mooncakes
2018	Synthesis of a novel metal cation fluorescent probe and its application in wastewater detection
2018	Assessment of indoor air quality on university campus
2018	Advance on adsorption behavior of bamboo charcoal for heavy metal elements
2017	Synthesis and Characterization of Schiff Base Compounds
2017	Synthesis and Properties of Nitrogen-containing Heterocyclic Compounds
2017	Synthesis and Properties of Acylhydrazides and Their Complexes
2017	Synthesis and properties of phenylpyrazole derivatives
2017	Synthesis and Properties of Coumarin Derivatives
2017	Study on the Application of Cyanuric Chloride/Manganese Dichloride Catalyst in Beckmann Rearrangement of Ketone
2017	Preparation of silver-doped nano-titanium dioxide film and its degradation properties
2017	Preparation and Application of β-Cyclodextrin Magnetic Polymers on Decomposition of Contaminants in the Water
2017	Composition and treatment of paper-making sewage in Zhejiang Province
2017	Progress in application of nano titanium dioxide in indoor air pollution control
2017	Preparation and application of magnetic nano-scale catalyst

2. Topic of thesis from practice

2.1 “Commodity inspection” direction

“Commodity inspection” direction was set up to cultivate students capable of inspection and

monitoring of chemical, drug, food, environmental, energy and material industries. Topics for this direction were all derived from practice as listed in Table 1.

2.2 "Foreign trade of chemical products" direction

"Foreign trade of chemical products" direction was set up to cultivate students capable of trade and marketing in chemical, drug, food, environmental, energy and material industries. Topics for this direction were all derived from practice as listed in Table 2.

Table 2. Topic for students of "Foreign trade of chemical products" direction

Year	Topic
2018	Analysis on the trend of chemical products trade in Jiangsu, Zhejiang and Shanghai
2018	Investigation of pharmaceutical and chemical import and export in Zhejiang Province based on "One Belt and One Road"
2018	Energy trade in "One Belt and One Road"
2018	The development and countermeasures of China-European railway express
2018	Problems and countermeasures for marketing model of chemical reagents
2017	Analysis of the Development for International Trade between China and Latin American
2017	Research on Output of Higher Education in America
2017	Input-output analysis of carbon emissions embodied in China-Japan trade

Students from both directions are popularly accepted by employers. Part of them became graduate students for further study; others went to industries (chemical, drug, food, environmental, energy or material) and engaged in analytical or research work for "Commodity inspection" direction; the rest of them went to industries and engaged in trade work for daily chemicals, pharmaceuticals, cosmetics, agrochemicals and adhesives for "Foreign trade of chemical products" direction.

3. Selection of characterized teaching contents

3.1 Literature Reading and Paper Writing

The course of "Literature Reading and Paper Writing" aims at helping students work more effectively through publication and oral presentation, also improving their ability in writing graduation thesis. This course was taught in the seventh semester in college, right before graduation thesis; therefore the contents in class was supposed to be application-oriented and served for improvement of BA thesis.

The contents of the class include: (1) Introduction of scientific writing and presentation, different kinds of scientific communication was introduced (reports, thesis/ dissertation, papers, talks, posters), and the principals of scientific writing and presentation were emphasized in this part. (2) Effective writing (Fig.1), the key point of clear writing is clear thinking. Rules of effective writing, and ways to manage the time effectively were recommended, notes for literature search, review and citation were introduced, and the important role of refining and proofreading was explained, further attention should be paid to avoid common errors during the draft process. (3) How to write a scientific paper, Introduction, Materials and Methods, and Results and Discussion were the basic parts of a scientific paper, which are well-known as IMRAD. Use the "Process Approach" to plan and layout the paper; remember the first draft is just a draft. A good abstract and introduction can gain a good impression during the peer-reviewed process, and try to

get feedback from others before submission. (4) How to publish a paper, choose a specialized journal over a popular one, check the impact factors and citations for the paper published in recent issues, introduce the documents should be prepared in the submission phase (manuscript, tables and figures, cover letter, comments to editors, suggested reviewers and opposed reviewers), and present skills how to respond to referees. (5) How to present a poster, the structure of a poster and how people read it was introduced, the way to present data and organize the poster, and the difference of poster from a paper was compared, examples of good and bad posters were showed in class to give further impression. For homework, students were asked to finish a poster based on the topic of their own thesis for practice (Fig.2). (6) How to prepare a scientific talk, the structure of a scientific talk was introduced, the way to present data and organize the scientific talk, and the difference of scientific talk from a paper was compared, examples of good and bad scientific talk were showed in class to give further impression. (7) How to give an effective talk, the key for a good presentation was focused, information should be included or eliminated was discussed, the audience (specific technical audience, general technical audience, or non- technical audience,) should be defined, coping with the nerves and keep calm should be remembered, the attitude to respond to questions should be cared. For class participation, students were asked to prepare a scientific talk of about 5 minutes, based on the topic of their own thesis for practice.

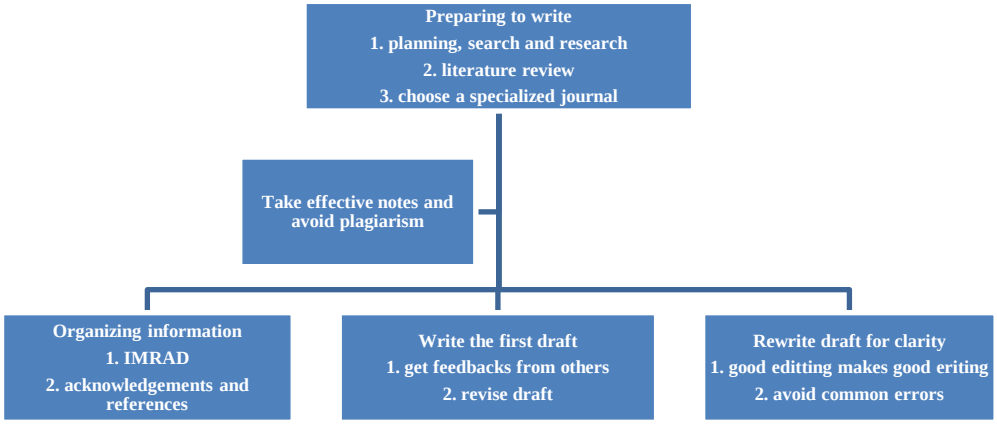

Fig. 1. Procedure for effective writing [3].

In the “Literature reading” part, a case study was given to the students on the core components of the literature. IMRAD including Introduction, Materials and Methods, and Results and Discussion were the basic parts of a scientific paper (Piar Chand, Ruchi Sharma, Ramdeen Prasad, Rakesh Kumar Sud, Yogesh B. Pakade. “Determination of Essential & Toxic Metals and Its Transversal Pattern from Soil to Tea Brew.” *Food and Nutrition Science* 2 (2011): 1160.). Students were expected to improve their own ability in comprehensive analysis through reading literature materials, and clearly and accurately express their personal opinions through paper writing [4]. The rules of paper reading, the structure of the paper, and the skills of getting effective information from scientific paper were taught in the class. For Introduction, students should read and solve the following four problems: (1) What is the problem being addressed? (2) Why is it important? (3) What have others done to address the problem? (4) What can you do to address the problem and how is it novel? For Material & Methods, students should read and solve the following four problems: (1) Which objective is being addressed by each experiment? (2) Are the treatments and experimental design defined clearly? (3) Can the procedure be repeated accurately? (4)

How was significance determined, and how are findings presented? For Results & Discussion, students should read and solve the following four problems: (1) What are the findings relevant to each objective? (2) Have all objectives been met? (3) How do the findings support or contradict to other work, and why? (4) What are the practical implications and what further work is needed?

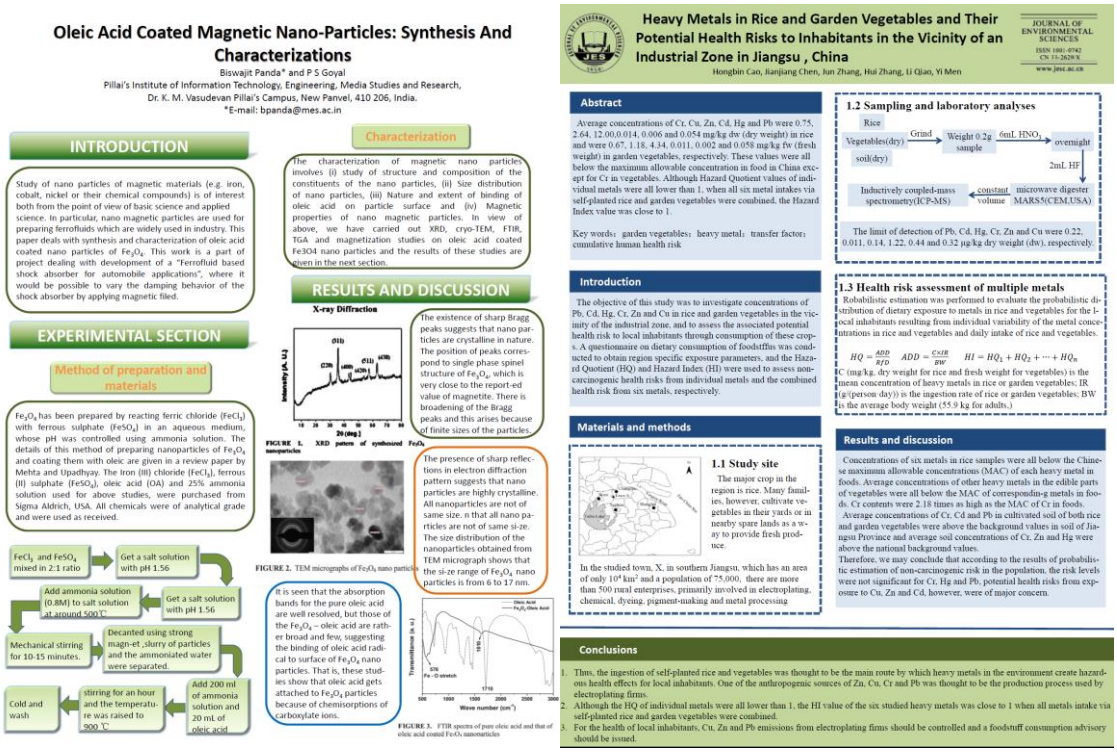

Fig. 2. Posters students made based on the references related to their thesis.

In the sample paper [5], for Introduction, students found that tea is grown commercially over 30 countries, and is one of the most popular beverages in the world. Several studies have revealed the potential health risk from the heavy metal contents in the tea, and the source of heavy metal contamination in tea could be uptake from the soil. Elements such as Cr, Fe, Co, Ni, Cu, Zn and Cd have been observed at μg/L level, and essential elements such as Ca, Na, K, Mg and Mn have been observed at mg/g level. The present study was proposed to assess the uptake level of essential and toxic metals from soil to tea leaves and infusion of the tea garden plot that are grown in Institute farm. For Material & Methods, students found that nine sampling spots were chosen for collection of soil, fresh tea leaves in descending order (Upper, Middle, and Lower location). The collected soil samples were subjected to measurement of fundamental chemical properties (pH, % carbon, % nitrogen, % phosphorus, and % potassium) and heavy metal concentrations. Recovery tests were conducted for both the soil and leaves sample by non-spiked and spiked samples, and all samples were test in three replicates. For Results & Discussion, method recoveries of metal in soil (80-112%) and tea leaves (41-105%) were presented, physico-chemical characterization of tea was discussed, heavy metal concentrations in soil were calculated and heavy metal concentration were compared among fresh leaves, made tea and tea brew. This study determined levels of toxic and essential heavy metal in tea garden soil, and its dissipation from fresh tea leaves to infusion. The concentration of toxic heavy metals Pb, Ni and Cd in tea leaves, made tea and its infusions were too low or not detected in this study. Essential metal concentration of Mn, Fe, Zn,

and Cu in the tea leaves decreased in the order of Mn > Fe > Zn > Cu. The level of most abundant essential heavy metals in tea infusion was Zn ranging from (0.09 - 0.52 mg/kg) followed by Mn (0.10 - 0.42 mg/kg). The results can provide reference for environmental impact assessment for maintenance of tea quality and sustainable development of tea production in this area. The findings of this study confirm the pollution in this area is much better compared to the data reported in elsewhere around the world. However, they believe the transversal pattern of heavy metal pollution from soil to tea brew has not been well addressed.

Students are required to pass the test of academic misconduct checking system, or else they won't be qualified to attend the thesis defense and may fail to graduate in time. Therefore, students are required to understand the severity of academic fraud and avoid intentional or unintentional plagiarism. Plagiarism is a serious violation of academic rules for undergraduates, graduates, and faculty alike [6, 7]. Clear markings should be used to distinguish your comments from the author's language, prevent any kinds of accidental plagiarism [8, 9].

Overall, by learning this course, students can master these applicable skills for finishing undergraduate thesis, understand the topic of journal paper, conducting literature research, data analysis, writing the first draft, editing the draft, making posters for conference, and presenting a scientific talk.

3.2 Fine Chemicals

Fine chemicals are important components of the universe of chemicals, though only account for 4% of the whole industry. Fine chemicals include the following aspects [10]: additives and catalysts, biocides, dyestuffs and pigments, electronic chemicals, flavors and fragrances, food and feed additives, household and personal care, life science products, specialty polymers, standard and advanced intermediates, active substances for specialties, especially drugs (human and veterinary) and pesticides.

The graduates majored in applied chemistry mostly went to companies engaging in flavors and fragrances, household and personal care, life science products, and pharmaceuticals. As for the purpose of cultivating applied talents, the contents of the class were carefully chosen based on the advanced information of the industry and the market. The market size and structure was introduced to help students to understand the general information of the industry. However, it is not possible to exactly determine the size of the fine chemical market for three main reasons. (1) The definition was not clear based on the threshold of "10 dollars per kilogram", for example, vitamin B_3 is classified as commodity, but vitamin H, vitamin D and E as fine chemicals. Similar occurs within amino acids with vitamins, where D, L-methionine and L-lysine are commodities, whereas L-proline and L-tryptophane are fine chemicals. (2) The total value of the industry is consisting of two aspects, the traded production values (merchant value) and the manufactured production values (captive value). (3) The official trade and custom statistics are not broken down to fine chemicals [10]. The U. S. Bureau of the Census classification, for instance, uses the following main product categories: "organic chemicals", "inorganic chemicals", "plastics", "fertilizers", "pharmaceuticals", "dyes and colorants" and "other". The leading companies in this subject, Akzo Nobel, Dow, Du Pont, Evonik, Chemtura, and Mitsubishi are introduced for further discussion.

The history of the fine chemical industry was revealed, three boom and two bust phases since 1970s was emphasized. The first boom led to the creation of the industry by histamine H_2 receptor antagonist, the second boom was brought by increasing demand for anti-AIDS drugs and COX-2 inhibitors, the third-minor-boom was associated with a possible avian flu epidemic, causing stockpiling of GlaxoSmithKline's Relenza (zanamivir) and Roche's Tamiflu (oseltamivir phosphate) all over the world.

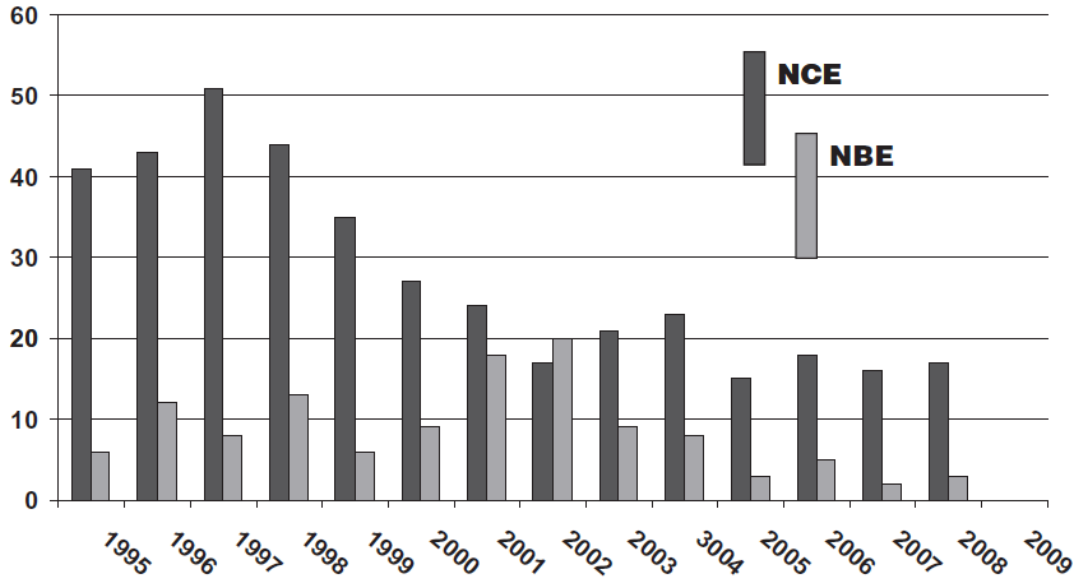

Fig. 3. FDA approvals for new APIs, 1995-2008 [10].

The demand for fine chemicals was mostly devoted by pharmaceutical industry, as the largest customer base for the industry. The innovator pharma industry went back because less new drugs are entering, while the generic companies are profiting from nonproprietary drugs that have lost patent protection. To some extent, the statistic of new drug approvals is a valid indicator for the trend of demand. The FDA approvals of new drugs were based on both small molecules (new chemical entities, NCEs) and big molecules (new biological entities, NBEs). The trend of approvals for new active pharmaceutical ingredients (APIs) was shown in Fig.3, the number of new APIs launched does not exactly correlate with the new sales generated in the same year, because the sales volumes and unit prices differ for each individual product. The Boston Consulting Company (BCG) found that at least three new drugs must be launched, if a big pharma company wants to maintain a growth rate in the low double-digit figure. The research and development (R&D) expenditure was really high for the pharma industry, which accounted for 15-20 % of the sales. The drug discovery process was long lasting and with a high degree of failure, usually from 10 to 14 years. Therefore, the western companies have suffered from the reduced demand for custom manufacturing services, and the Asian companies have benefited from the generic boom.

Top 10 innovator and generic pharma companies, top 10 proprietary drugs were introduced to students for basic understanding of the pharma industry. Top 10 innovator pharma companies were Pfizer (USA), Roche (Switzerland), GlaxoSmithKline (UK), Sanofi Aventis (France), AstraZeneca (UK), Novartis (Switzerland), Merck & Co., (USA), Johnson & Johnson (USA), Eli Lilly (USA), Abbot (USA). Top 10 generic pharma companies were Teva (Israel), Sandoz (Switzerland), Mylan (USA), Watson (USA), Hospira (USA), Ratiopharm (Germany), Stada (Germany), Sanofi (France), Actavis (Iceland), Ranbaxy (India). Top 10 proprietary drugs were listed as follows: (1) Lipitor by Pfizer, with API of Atorvastatin (I). (2) Plavix by Bristol-Myers Squibb and Sanofi Aventis, with API of Clopidogrel (II). (3) Enbrel by Amgen, Pfizer and Takeda, with API of Etanecerpt HMW. (4) Advair/Seretide by GlaxoSmithKline, with API of Salmeterol+(IIIa) and Fluticasone (IIIb). (5) Remicade by Johnson & Johnson and Merck, with API of Infliximab HMW. (6) Avastin by Roche, with API of Bevacizumab

HMW. (7) Diovan & Co-Diovan by Novartis, with API of Valsartan (IV). (8) Mabthera/Rituxan by Roche, with API of Rituximab HMW. (9) Abilifly by Bristol-Myers Squibb and Sanofi Aventis, with API of Aripiprazol (V). (10) Humira by Abbott, with API of Adalimubab HMW.

4. Practical teaching

4.1 Presentation of reference share in class

Students are asked to give an oral presentation on the topic of the undergraduate thesis; the reference share in the class can be the one for translation section of the thesis. They can translate the paper from a specialized journal first, and then collect related information to have a presentation. They are also encouraged to share the topic in English. Students both in "Commodity inspection" and "Foreign trade of chemical products" direction are required to have excellent skills in English listening, speaking, reading and writing, therefore the practice in class can improve their English proficiency.

As applied chemistry is an integrated major, the topic students chose covering both "Commodity inspection" and "Foreign trade of chemical products" direction. The "Commodity inspection" direction focused on contents and methods for determination of heavy metals, organic pollutants (agrochemicals, fertilizers, feed additives and other pollutants) in plants, soils, dairy products, forestall products, and food. The "Foreign trade of chemical products" direction focused on the trade associated with "One belt, One Road", the commodity trade between China and other developing countries, and also the energy trade. Students with similar topic were required to form a group and have a further discussion on the advantages and disadvantages of the translations. Other students in class are also encouraged to raise questions about the presentations. In a word, the new teaching model offered to cultivate students with more practical skills and more close to the demand of applied talents.

4.2 Innovator form of thesis

The bachelor thesis is one of the most important components of talent cultivating project in universities, it is a vital phase for practical teaching of basic training on scientific research, improving of integrated abilities, and cultivating innovation spirit for undergraduate students. For the purpose of cultivating applied talents, new form of thesis was setup to encourage participation of students in specialized competition, social practice and scientific research.

Students who have one of the following achievements are considered as finishing the undergraduate thesis: (1) Publish one or more paper in the specialized journal (core journals according to the index by ZISU). (2) Preside over an undergraduate science and technology innovation project or undergraduate innovation and entrepreneur training project with province level. (3) Get the third prize or higher for the "A-level" competition confirmed by Zhejiang Education Department. (4) Acquisition of copyright of computer software, patent for invention, patent for utility models and design patent. (5) Entrepreneur project for undergraduate.

However, one prize for the competition or one patent can only affirm one thesis. The first author should submit the copy and original documents of prize or paper, other authors should submit supplementary materials including agreements of other partner.

Overall, this innovator form of thesis encourage the students to involve in activities with more practical attributes, such as undergraduate science and technology innovation project, undergraduate innovation and entrepreneur training project, specialized competition and entrepreneur project for undergraduate. This kind of experience is more satisfied the demand for applied talents.

5. Multiple assessments of the course

Traditional assessment of the course is composed of homework, attendance, midterm exam, and final exam; multiple assessments are adopted for the capability-oriented assessment system. For the course of "Literature Reading and Paper Writing", in-class activity of topic discussion, oral presentation of reference share was added to the assessment system. The final exam was not answers to questions, but finishing a poster based on a reference related to the topic of thesis. The quality of the poster will reflect whether the students pay attention to the "poster" lecture carefully, therefore it is another way to examine the quality of in-class activity. Each student has a different reference based on their own thesis; it is also an effective way to avoid cheating in the final exam by submission of a poster; the students were expected to finish the poster independently on their own. The final score for this course was divided into three parts: Part 1 (homework, attendance and in-class activity) accounted for 20% for the final score, part 2 (oral presentation) and part 3 (poster) accounted for 30% and 50% for the final score, respectively.

Feedback was collected from the students every year for improvements of the course. The excellent rate for the final account and final exam has significantly improved year by year. Students graduated from the university, whether went to work, or went to post-graduate reexamination, claimed that they really benefited from the experience of selected reading practice and presentation in "Literature Reading and Paper Writing". They were asked to express the thesis in English, which help them build confidence in spoken specialty English.

6. Conclusions

Teaching reform on courses and undergraduate thesis is a tentative practice and necessary way for cultivating applied talents in foreign language oriented university, to achieve the objective of "combining professional knowledge and foreign languages together" for application-oriented undergraduate university of ZISU. Selected reading and application-oriented presentation were used to conduct the course reform of "Literature Reading and Paper Writing". Topics associated with both "Foreign trade of chemical products" and "Commodity inspection" directions were selected for the thesis. The innovator form of thesis was created, to encourage students to participate in kinds of training project or specialized competition. In the future, more effort is needed to strengthen the implementation of reform on courses and undergraduate thesis, to cultivate more students with applied talents.

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