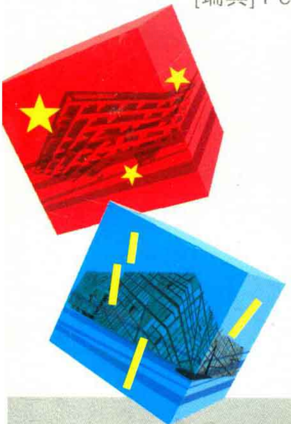
[瑞典] Per-Olof Wickman, Bengt-Olov Molande [中国] 赵长林 李晶/编著

赵长林、谷红斌/编译



中瑞两国科学课程改革：

Science Curriculum Reform in China and Sweden :

通过探究性学习发展学生科学素养的比较

Comparing Implementation of Scientific Literacy through Inquiry Based Learning

廣東出版集團 全国优秀出版社 全国百佳图书出版单位 广东教育出版社

[瑞典]Per-Olof Wickman, Bengt-Olov Molande [中国]赵长林 李晶/编著
赵长林、谷红斌/编译

中瑞两国科学课程改革：

Science Curriculum Reform in China and Sweden:

通过探究性学习发展学生科学素养的比较

Comparing Implementation of Scientific Literacy through Inquiry Based Learning

廣東省出版集團
全国优秀出版社
全国百佳图书出版单位 广东教育出版社
·广州·

图书在版编目（CIP）数据

中瑞两国科学课程改革：通过探究性学习发展学生科学素养的比较/（瑞典）威克曼（Wickman，P. O.）等编著；赵长林，谷红斌编译. —广州：广东教育出版社，2012. 5
ISBN 978-7-5406-9041-0

Ⅰ. ①中… Ⅱ. ①威… ②赵… ③谷… Ⅲ. ①基础教育—课程改革—对比研究—中国、瑞典 Ⅳ. ①G639. 21 ②G639. 532. 1

中国版本图书馆 CIP 数据核字（2012）第 079327 号

责任编辑：靳 辉
责任技编：肖作勤
封面设计：陈宇丹

广 东 教 育 出 版 社 出 版 发 行
（广州市环市东路 472 号 12－15 楼）
邮政编码：510075
网址：http：//www. gjs. cn
广东新华发行集团股份有限公司经销
佛 山 市 浩 文 彩 色 印 刷 有 限 公 司
（南海区狮山科技工业园 A 区）
889 毫米×1194 毫米 32 开本 4. 25 印张 106 000 字
2012 年 5 月第 1 版 2012 年 5 月第 1 次印刷
印数 1—1 500 册
ISBN 978-7-5406-9041-0
定价：22. 00 元
质量监督电话：020-87613102 购书咨询电话：020-87621848

前言

呈现给大家的这本小册子是瑞典—亚洲合作项目科学教育课题组的研究报告。该项目由聊城大学、北京教育学院、斯德哥尔摩教育学院（现斯德哥尔摩大学教育学院）的研究人员合作完成，由瑞典国际开发合作署全额资助（Swedish International Development Cooperation Agency）。斯德哥尔摩大学教育学院的研究人员主要有 Per-Olof Wickman、Bengt-Olov Molander，北京教育学院参与课题研究的人员主要有李晶、何妮妮、胡玉华，聊城大学参与课题研究的人员主要有赵长林、赵汝木、胡家会，研究生谷红斌、梁红梅也参加了本课题的部分研究工作。最终研究报告由 Per-Olof Wickman、Bengt-Olov Molander 和赵长林执笔完成，编译工作由赵长林、谷红斌合作完成。由于水平有限，加之时间仓促，本书错漏缺点在所难免。这本小册子可供科学教育专业本科生和科学教师参考，对从事科学教育研究的学者也有一定的参考价值。

本书的出版由瑞典国际开发合作署和瑞典研究理事会全额资助，并得到广东教育出版社李朝明先生、聊城大学国际交流学院的宋延亭女士、斯德哥尔摩大学 Gunilla 博士、Richard Hager 博士的大力支持，在此一并表示感谢。

Preface

This booklet is the science education group's paper resulting from the Sweden-Asia Cooperation project which was undertaken by researchers of Liaocheng University, Beijing Institute of Education and Stockholm Institute of Education (now integrated into Stockholm University), and it is funded by Swedish International Development Cooperation Agency (SIDA) and the Swedish Research Council (VR) under the leadership of Professor Häkan Larsson. The researchers of Stockholm University are Per-Olof Wickman and Bengt-Olov Molander, the researchers of Beijing Institute of Education are JingLi, Nini He and Yuhua Hu. The researchers of Liaocheng Univesity are Changlin Zhao, Rumu Zhao and Jiahui Hu. Graduates Hongbin Gu and Hongmei Liang also attended the project. This last paper of the project is written by Per-Olof Wickman、Bengt-Olov Molander and Changlin Zhao, and translated by Changlin Zhao and Hongbin Gu. Owing to the limitation of our knowledge and lack of time, the book contains mistakes and inevitable shortcomings. We hope readers excuse our errors. This booklet can be used by science education undergraduate students and science teachers, and could be refered to by science education researchers too.

This booklet is the book published by the funding of the Swedish International Development Cooperation Agency (SIDA) and the Swedish Research Council (VR), and Mr. Chaoming Li of Guangdong Education Publishing Company, Dean Yanting Song of Liaocheng University International office. Doctor Gunilla Höjlund and Richard Hager of Stockholm University etc. all gave us support, and here we gratefully acknowledge this.

目 录
Contents

Introduction

The main question for this article is related to curriculum reforms regarding the teaching of scientific literacy through inquiry-based learning (IBL). Reforms of very similar intentions in this regard are common in countries all over the world, and they are common to China and Sweden. At an international workshop in Stockholm, 2005, arranged by the InterAcademy Panel on International Issues (IAP, a network of National Science Academies of the world) on Inquiry Based Learning Programs, delegates of 28 nations from all continents were represented (InterAcademy Panel Workshop, 2005), and among them China and Sweden.

The international interest demonstrates the expectations of influential stakeholders in science education on inquiry based learning as a major method and content of teaching science. In a recent expert group report—the so called Rocard Report—The European Commission recently stated that "A reversal of school's science-teaching pedagogy from mainly deductive to inquiry-based methods provides the means to increase interest in science" (European Commission, 2007, p. 12) and recommended a budget of 60 million Euros over the next six years to support inquiry-teaching programs. As will become evident similar expectations on IBL reforms for scientific literacy (SL) and interest in science can be found nationally in China and Sweden.

This study is about what happens to these reforms depending on national and more local contexts. In this study we first aim to describe how society in different ways tries to promote the intentions of an IBL reform in schools and second we describe what is actually happening in schools.

What are Inquiry, IBL, and SL?

Before it is possible to analyze the implementation of scientific literacy through IBL in national curricula, it is necessary to look closer at how inquiry, IBL and SL have been defined in the international discussion. The idea of inquiry can be traced to the United States and the works of John Dewey more than a century ago (Olsen & Loucks-Horsley, 2000). The notion of IBL as the way of teaching science is currently strong in the U. S. Not surprisingly, one very influential definition of scientific inquiry internationally is the one used in the U. S. National Science Education Standards, namely as

> a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations. (Olsen & Loucks-Horsley, 2000, p. 13 – 14)

In this restricted scientific sense, inquiry deals with the cycle of (1) asking questions, (2) collecting data, (3) discussing how the data can be used as evidence to answer the questions. In an extended sense, inquiry also has come to include the competence to deal with socio-scientific issues and issues about science, technology and society (Roberts, 2007; Sadler, 2007; Zeidler 2007). Such problems typically deal with a social issue where scientific knowledge needs to be related to knowledge within other areas such as economics, technology and social sciences to make wise decisions within areas such as politics, human welfare or sustainable development. Hence, in the extended sense inquiry deals not only with establishing facts, but also with human values. In the more general sense, including both scientific inquiry and inquiry extended, inquiry (1) situates a question within an issue (scientific, technological or societal), (2) collects data and relates them to the interest or values in which the question is embedded, and (3) deliberates more generally about how the data can be used as evidence and be related to human interest to solve the issue at stake (Wickman, 2006).

Knowledge in both the restricted scientific sense and in the more extended socio-scientific sense is needed to include all issues that are encompassed by the concept of SL. We will here define SL as the capacity of making inquiries in the more general sense. It is also defined as having to do with capacities that are needed by all citizens and not specifically by those that are going to pursue a scientific career (Roberts, 2007). The extended sense of scientific literacy for example is the one adopted in the international PISA study, and it refers to an individual's:

- Scientific knowledge and use of that knowledge to identify questions, acquire new knowledge, explain scientific phenomena and draw evidence-based conclusions about science-related issues
- Understanding of the characteristic features of science as a form of human knowledge and enquiry
- Awareness of how science and technology shape our material, intellectual, and cultural environments
- Willingness to engage in science-related issues and with the ideas of science, as a reflective citizen

(Programme for International Student Assessment, 2006, p. 23)

Hence, curricular reforms regarding the teaching of SL through IBL is identified as efforts to teach students the capacity of making inquiries in the more general sense by using inquiry in the inclusive sense in the classroom to learn SL.

Theoretical Framework

Curriculum reform traditionally could be seen as initiated by the regulations and standards put forward by national or local governments and as implemented by the schools through the work by teachers with their students. A study of curriculum reform according to this linear scenario would be one of examining how the *intended curriculum* is transformed by teachers as the *taught curriculum* and eventually as the *learned curriculum* by students (Cuban, 1992).

However, this linear picture in many ways is too simple to fully understand systemic reform, where there are many more actors than at these three levels (Beeth, Duit, Prenzel, Ostermeier, Tytler & Wickman, 2003). As will become evident, curriculum reform is not fully formulated at the national or regional level where documents are produced. A written document lacks certain aspects (in Sweden for instance instructions about how to carry out the aims of the national curriculum) and it is also documents where various actors with different degrees of understanding of education and its goals have negotiated partly conflicting standpoints, which will remain in the documents (Englund, 1998). Besides, different actors represent different customary ways of focusing specific aspects, whereas other aspects are overlooked or are not seen as critical.

These various ways of approaching the content and ways of teaching can be said to represent various *selective traditions* (Williams, 1973). Such selective traditions are not completely homogenous at different levels of formulation and application and they may also vary between countries and regions. Steering documents need to be re-formulated and interpreted at all levels of reform and there is not one single version of what the resulting taught or learned curriculum should be to represent it correctly. For this reason curriculum reform should not be seen just as a more or less successful implementation of certain aims, but as a continuous negotiation between all parties involved about what the purposes of science education are and how they best could be achieved. Within such a scenario of understanding curriculum reform a detailed comparison of two countries could be illuminating for reflection of traditions taken for granted.

For these reasons we have chosen to describe the background of curriculum reform in a comprehensive manner. Hence, the organization of control of the teaching and learning in classrooms is first described for all of the following levels:

1) National governmental control
   - i. National steering documents
   - ii. National exams
   - iii. Pre-service teacher education
   - iv. In-service teacher education
2) Private and local initiatives
   - i. Private initiatives
   - ii. Local public authorities
   - iii. School and teachers
   - iv. Parents and students

This constitutes a comprehensive description of how the curriculum and pedagogy of schools are controlled by various actors and stakeholders.

Second a description is made of how these different bodies describe the learning aims and pedagogy of IBL and the references they use to defend these aims and methods of teaching. This constitutes a description of the current purposes in China and Sweden, respectively: What IBL is expected to look like and reasons given.

Finally a description is made of the actual change found so far, i. e.

1) The starting point: what teaching typically looks like in classroom before IBL reform
2) The results achieved: what teaching typically looks like in classrooms with IBL

This constitutes a measure of the actual reform made so far and regarding what could be said at this point in time. The first item is also an important description of the school culture setting of our two nations.

From this the context of curricular change in China and Sweden is described and some tentative conclusions can be made about how negotiated curricular intentions have resulted in a taught and learned curriculum by comparing our two countries. To summarize our research questions are:

- What do intentions regarding IBL and learning SL look like in China and Sweden?
- Who are the actors in these reforms and what are the settings where these are formulated?
- What have happened to these intentions and reforms when set in motion in schools by teachers and students?
- What more general conclusions may be drawn about how curriculum reform can be better supported?

We begin by describing curriculum control in two countries to give an idea of the actors and more general settings for the curricular reforms. After that follow descriptions of the reasons and intentions for reforms, the starting points and the results achieved so far. We end by giving a tentative account of the relationships between conditions of curriculum reform and the results achieved and what this may mean for supporting curriculum reform.

Curriculum Control

In China

China has a nine-year compulsory school, composed of a six-year primary school and a three-year secondary school. The three-year upper secondary school is optional and has both academic and vocational programs. In 2010, Students of Vocational High Schools are 3,131,735, Students of academic high schools are 24,342,783 (China Statistical Yearbook 1999). In most districts of China the students who want to continue from compulsory to upper secondary school must attend Upper Secondary School Entrance Examination. Students' admission to high schools is based on their score in these examinations. There is a fierce competition of admission to senior high schools that are likely to favor high scores in University Entrance Examination. In most districts of China, admission to middle vocational schools is not as competitive and students' applications to these schools are generally accepted. Compulsory education is free of charge. However, the Law of Promoting Private-run Education encourages public organizations or individuals, other than State organs, to establish and run schools and other institutions of education with non-governmental financial funds. Private education is currently developing, mainly with regards to the non-compulsory system.

The school system is goal-based with a division between national and regional responsibilities. According to the Compulsory Education Law, the main responsibility for compulsory education activities lies with the county government. The National People's Congress set out overall national goals in the Education Act for the preschool, compulsory school system and the non-compulsory school system. The Basic Education Department of Ministry of Education draws up what curricula should be offered and all the state curricula standards in preschool, compulsory school and upper secondary school. At the provincial level, each Basic Education Office of Provincial Education Department, administer the state curriculum implementation and draws up the local curricula program. The city and county Basic Education office of Education Department mainly administer the state and local curriculum implementation (for further details see http://www.moe.edu.cn/edoas/website18/78/info4178.htm.)

Other important departments which influence curriculum reform are the Teaching Research Office and the Education Research Institute. In the province, city and county education departments all have the two organizations. The Teaching Research Office main responsibility is to evaluate teachers' level of instruction in the classroom. The standard of evaluating teachers' instruction quality is important factor to implement curriculum reform. This is because the evaluation score decides the teachers' professional titles, for example, the middle school advanced teacher, the middle school first-grade teacher, the middle school second-grade teacher etc. and their salary. The Education Research Institutes of the nation, province, city and county mainly administer teachers' education research topics. Every year the institutes issue education research topics to teachers from which the teachers apply.

The numbers and grade of applied education topics are also very important to a teacher's professional title and salary. So the national and local education research institutes could lead the curriculum reform through organizing education research.

There is a comprehensive curriculum standard for science. In primary school, science is taught as integrated science. From grade 3, in junior high school, the schools can choose to teach science as integrated science or as the separate subjects of biology, chemistry and physics. In high school, science is taught as separate subjects. For all grades of compulsory school, there is a timetable, which defines the minimum time of teacher-directed instruction hours in compulsory school. For example, the minimum time for instruction in Chinese is 1850 hours, mathematics 1200 hours, physical education and health 832 hours and English 555 hours. Science subjects (biology, chemistry, and physics) and technology has a minimum time of 752 hours.

The national Program for Elementary Education Curriculum Reform (Trial) issued by the Ministry of Education in June 2001, stipulates that the majority of courses in primary school are comprehensive. Science Education for primary school was renamed "Science" from the original "Nature for Primary School". Nature for Primary School was originally offered from Grade 1 to Grade 6, whereas Science for Primary School is offered from Grade 3 to Grade 6. The subjects Science for Primary School, "Morality Education and Life" (Grade 1 to Grade 2) and "Science" (or physics, chemistry and biology) for junior high school (Grade 7 to Grade 9) form Science teaching content for the nine consecutive years in compulsory school. Science instruction has increased from 8 hours/week to 10 hours/week since the change from Nature for primary school was changed to Science for primary school. In addition to science education content in Morality Education and Life for Grade 1 and Grade 2, the total hours of science education for primary school has been increased considerably.

The province or municipality Education Department can decide on a school plan for compulsory education at the different schools within the province or municipality. The Education Department can also further define local syllabi for the different subjects. However, most of the provinces and municipalities only transmit the state documents and timetables. In the very competitive school system, most of the schools and teachers do more than the state documents and timetable demands to reassure to get good results, in assessment on teaching quality as well as and in students' examinations.

China has a similar program as NTA in Sweden or Project 2061 in USA. They are the Outline of the Action Plan for the Nation's Scientific Literacy (2006) and the Outline of Scientific Literacy Education for Farmers (2007) which are issued by China Association for Science & Technology (CAST). The way CAST influences science curriculum reform is through campus schools and teachers who accept their projects.

Curriculum reform efforts are complicated. On the one hand there is a high degree of centralization. The national steering documents and standards of curriculum have mandatory power. On the other hand, there is room for adjustability with respect to local differences and preconditions. Pre-service teacher education is performed by universities, and is regulated by national government documents. The government must authorize undergraduate educational programs and recruitment of number of students by the universities. In-service education is the same as pre-service education.

There are many authorities that regulate working conditions for