STEM is an acronym for science, technology, engineering and mathematics. "It is designed to enable students to participate in learning based on activities, projects and problem solving. It provides a hands-on classroom experience where students learn mathematics and scientific knowledge to deal with the major challenges of the world when they create, design, construct, discover, cooperate and solve problems."[1] STEAM education founder Georgette Yakman believes that the original STEM education only concerned about the project itself (what and how to do), While ignoring the concern for the person itself and the background (who does and why), so STEM in the breadth and depth of interdisciplinary knowledge there are still some limitations, and in the teaching process of the lack of certain fun Sexual, artistic and artistic. Therefore, she will art (Arts) and STEM organic integration, and in 2006 put forward the concept of STEAM education. Yakman's art (Arts) refers not only to what we usually call art (music, art, etc.), but one contains the humanities (art, aesthetics, music, drama), physiology and social sciences (anthropology, Philosophy, etc.) of the concept. As a result, she classifies STEAM into nine major themes: Social Studies, Science, Mathematics, Language Arts, Technology, Engineering, Music, Fine Arts, and Physical Education.

Yakman held a series of STEAM lectures at the 79th Annual Conference on International Technology and Engineering Education Association (ITEEA) from March 15 to 18, 2017.
The cultivation of students' ability, how to effectively carry out STEAM teaching and evaluation and other important issues in-depth and practical explanation.

The future of the community more need to have the ability to integrate innovation, resource utilization, sensitive market awareness, understand the industrial production, with leadership talent. Therefore, future education will focus more on the ability of students to find problems, the ability to innovate imagination, the ability to create hands, the ability to integrate resources, the ability to communicate and coordinate the capacity of industrial production.

Yakman believes that STEAM education will develop students' abilities from a variety of perspectives.

- The combination of application skills and art design can improve students' attention to technology and aesthetics, and cultivate students' awareness of industrial production.

- By writing stories, context settings and other methods, can greatly active classroom atmosphere, to promote the enthusiasm of students to learn and hands-on practical ability, and then stimulate them to find problems, solve the problem.

- Broaden and extend the breadth and depth of interdisciplinary teaching, can greatly improve the students' ability to integrate resources.

- Can promote the balanced development of students around the brain, a high IQ, high intelligence business talent.

STEAM teaching and STEM, like the project to carry out the form. The Yakman design of the STEAM project consists of six links, namely "problem statement", "brainstorming, generating a program", "selecting a viable option", "performing a program", "testing evaluation", "redefining a problem, iteration" until the problem is solved properly.
In the implementation of specific courses, STEAM teaching teachers need to have a strong comprehensive ability, which will inevitably lead to lack of teachers. In this regard, Yakman suggested that the organization of different subject background teachers, teaching the same STEAM project with different teaching links, when students encounter the discipline of professional issues, you can find the corresponding disciplines of professional teachers to ask. This can greatly reduce the STEAM teaching requirements for all-round teachers, reduce the burden of teachers. At the same time, students can get more professional answers and guidance. Take STEAM Project as an Example to Explore the Relationship between Instrumental Pronunciation and Physical Structure. First, a team of teachers composed of music and physics teachers. Then, the music teacher from the development of musical instruments to explore the history, notes, sound and other music-related knowledge to start, and then the instrument and other disciplines at the intersection between enumerated, causing students to think. Next, the physics teacher combined with the instrument, together with the students to explore the relationship between the pronunciation of the instrument and the physical structure.

STEAM follows the developmental evaluation concept, and combines the various indexes of process evaluation, works evaluation, comprehensive activity evaluation and summary evaluation so that teachers' guiding role and student's main role can be combined. In the STEAM evaluation, Yakman believes that both students and teachers can be evaluated.

- for the evaluation of students, pay attention to the students of the process of evaluation, rather than the results of evaluation. This kind of process evaluation mainly takes two ways: classroom evaluation - design a series of classroom records, such as data records, engineering reports, etc., these tables from a number of dimensions of students in the classroom learning process performance; Activity evaluation - to carry out some extracurricular activities, such as the Museum held in the Museum of Science Day, by participating in these activities show to assess the students' learning outcomes.

- For teachers' evaluation, a specially designed project teaching record will also be used to assess the development and implementation of STEAM projects by teachers in the classroom. Thus, teachers can make teaching on the continuous reflection, optimization and promotion.

STEAM concept has been widely accepted by our basic education workers, but how to carry out STEAM specific teaching activities, and how to effectively evaluate the STEAM teaching and many other issues remain to be resolved. Yakman, with his many years of STEAM theory and first-line teaching experience, gives us inspiration, from which we will be more in-depth understanding of science, engineering, technology, mathematics is how to organically combined with the humanities to cultivate the core development of Chinese students.

公众号：中国科技教育
微信号：cnstedu
欢迎订阅和分享
STEM是科学、技术、工程与数学的缩写，“旨在使学生参与以活动、项目和问题解决为基础的学习，它提供了一种动手做的课堂体验。学生在应用所学到的数学和科学知识应对世界重大挑战时，他们创造、设计、建构、发现、合作并解决问题。”[1]STEAM教育的创始人Georgette Yakman认为，原有的STEM教育只关注项目本身（做什么和如何做），而忽略了对人本身和背景的关注（谁来做和为什么做），因此STEM在跨学科知识的广度和深度上仍存在着一定的局限性，并在其教学过程中缺乏一定的趣味性、情境性和艺术性。因此，她将艺术（Arts）与STEM进行有机融合，并在2006年提出了STEAM教育理念。Yakman所说的艺术（Arts）不仅是指我们平时所说的艺术学科（音乐、美术等），而是一个包含了人文学科（美术、美学、音乐、戏剧）、生理学和社会科学（人类学、哲学等）的大概念。由此，她将STEAM归类为9大主题：社会学（Social Studies）、科学（Science）、数学（Mathematics）、语言艺术（Language Arts）、技术（Technology）、工程（Engineering）、音乐（Music）、美术（Fine Arts），以及体育（Physical Education）。
Yakman在2017年3月15—18日，第79次国际技术与工程教育协会年会（International Technology and Engineering Education Association 79th Annual Conference，简称ITEEA）期间，举办了系列STEAM讲座，围绕STEAM教与学展开，从STEAM对学生能力的培养，如何有效开展STEAM教学及评价等重要问题进行了深入且实用的讲解。

未来社会更加需要具有创新整合能力、资源利用能力、敏感的市场意识、懂得工业化生产、具有领导力的人才。因此，未来的教育将会更加注重培养学生们发现问题的能力、创新想象的能力、动手创造的能力、资源整合的能力、沟通协调的能力及工业化生产的能力。

Yakman认为，STEAM教育将会从多种角度培养学生能力。

- 能够将应用技巧和艺术设计有机结合在一起，可提高学生对技术和美观的双重重视，培养学生对产品的工业化生产的意识。

- 通过编故事、情境设置等方法，可以极大地活跃课堂氛围，促进学生学习的积极性和动手实践能力，进而激发他们发现问题、解决问题的能力。
● 拓宽和延展了跨学科教学的广度和深度，可大大提高学生们的资源整合能力。

● 可以促进学生左右脑的均衡发展，成为高智商、高情商人才。

STEAM教学与STEM一样，多以项目的形式开展。Yakman设计的STEAM项目包含6个环节，分别是“问题陈述”“头脑风暴，产生方案”“选择可行方案”“执行方案”“测试评估”“重新定义问题，迭代”，直到恰当地解决问题。

图2  STEAM项目“探究乐器发音与物理结构的关系”

在具体的课程实施中，STEAM教学需要教师具有较强的综合能力，这样必然导致师资不足的问题。对此，Yakman建议，组织不同学科背景的教师，教授同一个STEAM项目的不同教学环节，当学生遇到该学科的专业性问题时，可以找相对应学科的专业教师请教。由此，可大大降低STEAM教学对全能型教师的要求，减轻授课教师的负担。同时，学生也能得到更加专业的解答和指导。以STEAM项目“探究乐器发音与物理结构的关系”为例。首先，由音乐和物理学科教师组成教师团队。然后，音乐教师从所探究乐器的发展历史、音符、音色等音乐相关知识入手，进而将该乐器与其他学科之间的交叉点列举出来，引发学生们思考。接下来，物理教师结合该乐器，与学生一起探讨乐器的发音与物理结构的关系。

STEAM遵循发展性评价理念，通过将过程性评价、作品评价、综合活动评价、总结性评价等多种评价结合，使教师的指导作用和学生的主体作用实现最佳结合。在STEAM评价方面，Yakman认为可以对学生和教师二者都进行评价。

● 对于学生的评价，注重学生的过程性评价，而非结果性评价。这种过程性的评价主要采取两种方式：课堂评价——设计一系列课堂记录表，如数据记录表、工程报
告表等，这些表能从多个维度考查学生在课堂学习过程中的表现；活动评价——开展一些课外展示活动，比如在博物馆举办家庭科学日，通过参加这些活动展示、评估学生们的学习成果。

对于教师的评价，也将使用特别设计的项目教学观察记录表，以此评估教师在课堂上开发并实施STEAM项目的情况。由此，可以让教师进行教学上的不断反思、优化和提升。

STEAM理念已被我国基础教育工作者广泛接受，但如何开展STEAM具体教学活动，以及如何有效评价STEAM教学等诸多问题仍有待解决。Yakman以其多年的STEAM理论研究和一线教学经验，给予我们启示，从中我们将更加深入地理解科学、工程、技术、数学是怎样有机地与人文学科相结合，以培养中国学生发展核心素养。