Is There Still A Future in STEM?

How we missed the mark, and what we can do to fix the problem!

"Facilitating Experiential & STEM Learning Opportunities"
Organized and Hosted by Hua Quan Village and Sino-Exchange
Presented at HuaQuan Village
By: Scott A. Campbell
September 22nd-24th

STEM 还有未来吗？

我们是如何错过目标的，以及我们能做些什么来解决这个问题！

主办促进体验式和 STEM 学习机会
由华泉小村、中外合作交流
在华泉村举办
作者：胡屹龙
9 月 22 日-24 日

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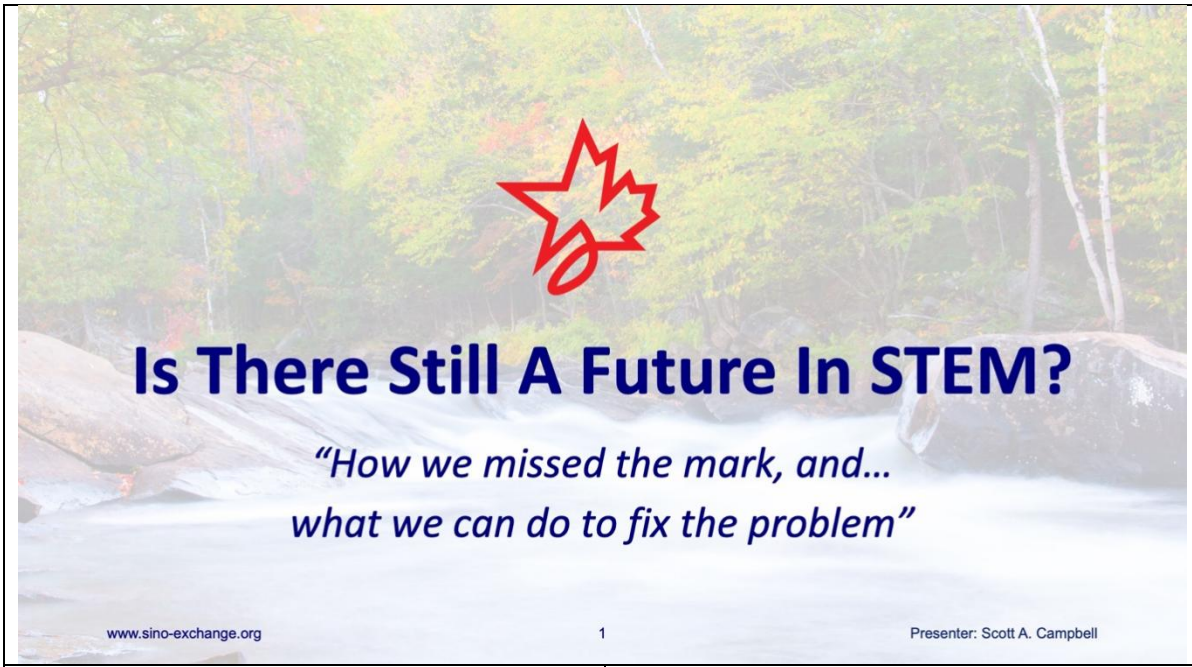
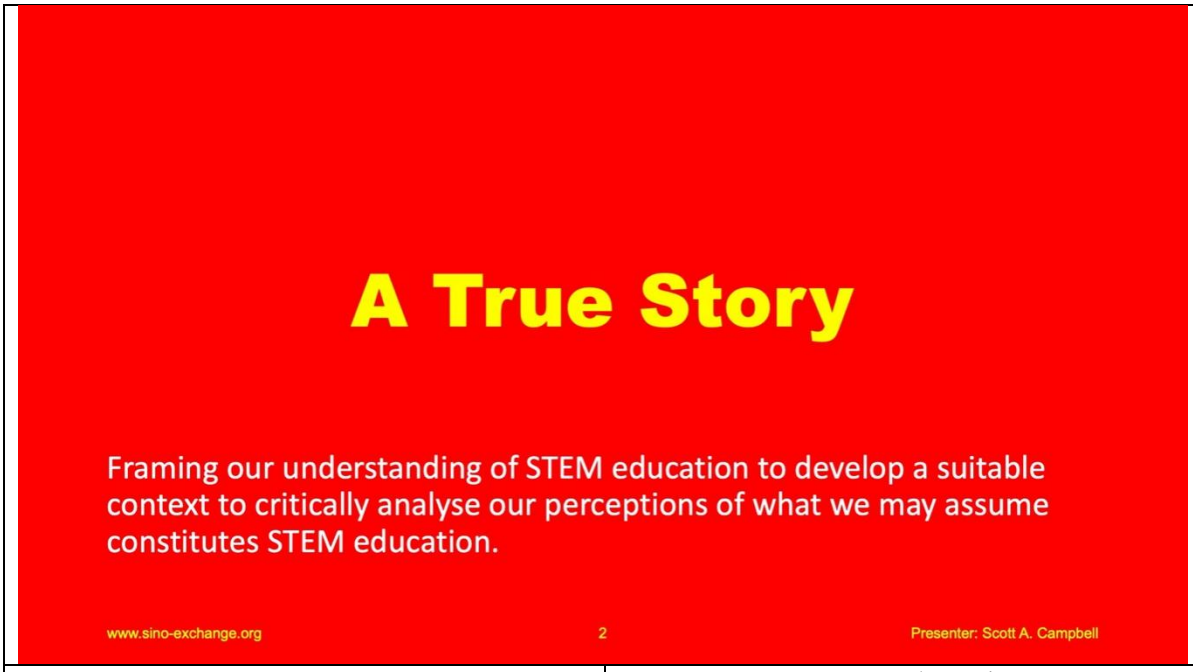
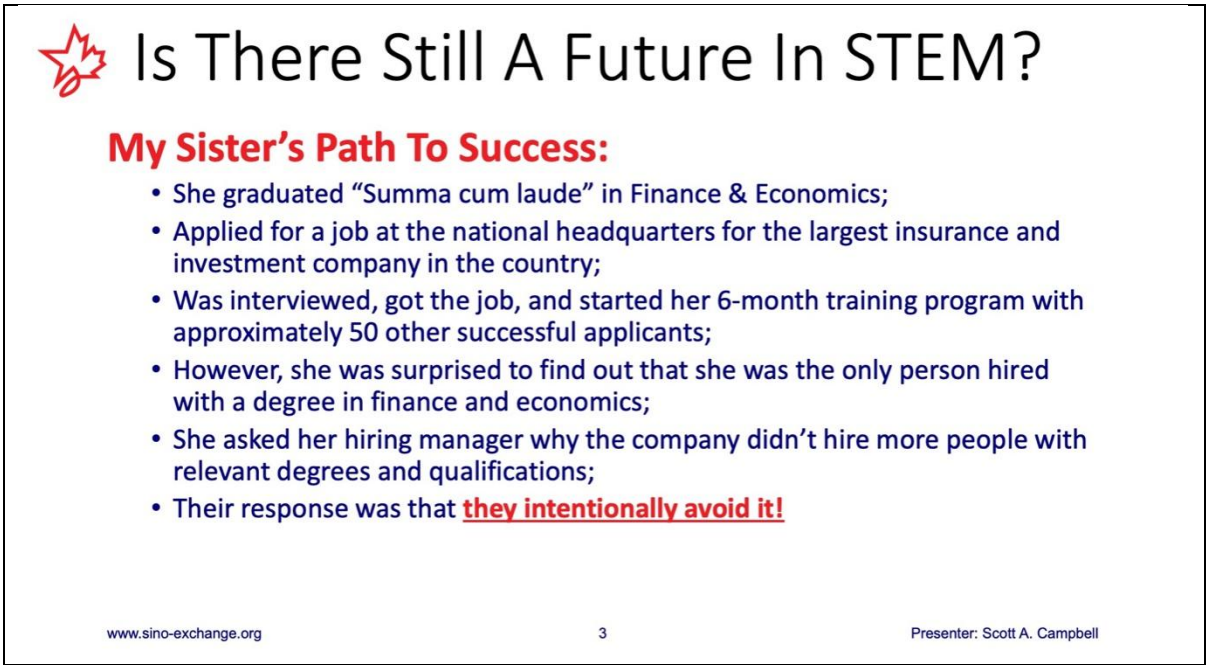


First, I would like to that everyone who has joined us for our educational symposium on Experiential Learning and STEM education. However, you might be shocked that the opening keynote address for is titled "Is There Still A Future In STEM". You might ask yourself, why start with such a critical opening address. But the answer is simple… I truly believe in STEM education; however, even great ideas are prone to failure if they are improperly implemented.	首先，我想感谢所有参加我们的体验式学习和 STEM 教育研讨会的人。然而，你可能会感到震惊的是，开幕式主题演讲题为"STEM 还有未来吗"。你可能会问自己，为什么要用这样一个关键的开场白。但答案很简单… 我真的相信 STEM 教育；然而，即使是伟大的想法，如果执行不当，也容易失败。
Therefore, this keynote isn't about condemning STEM, but about identifying the problems or obstacles that can seriously compromise the development of a quality STEM program… *Issues that if left uncheck could be detrimental to the continued development of the educational framework that we know as STEM education!*	因此，本主题演讲不是谴责 STEM，而是确定可能严重影响高质量 STEM 项目发展的问题或障碍……如果不加以控制，这些问题可能会对我们所知的 STEM 教育的教育框架的持续发展有害!
So, what I really want to do in today's presentation is to critically assess and evaluate the nature of STEM education so that we can develop rigours academic programs that up-hold the guiding principles that STEM was originally founded upon. To learn from our best practices, but also from our own mistakes as well.	因此，在今天的演讲中，我真正想做的是批判性地评估和评估 STEM 教育的本质，以便我们能够制定严格的学术计划，以支持 STEM 最初建立的指导原则。从我们的最佳实践中学习，也从我们自己的错误中学习。
	这就是这次演讲的真正寓意…"我们能做些什么来解决这个问题"…

And that's really the moral of this presentation… "What we can do to fix the problem" … But before we can fix any problem, we need to take the time to understand it. And with that in mind I would like to start by sharing a Chinese Proverb: "If your plan is for one year, plant rice. If your plan is for ten years, plant trees. If your plan is for one hundred years, educate children." And that's our goal today. To uphold a dream that's been almost 70 years in the making…. A dream that is shared amongst many nations to educate children so that they become more creative, to become critical thinkers, and to purse a dream that will one day lead their countries towards greatness.	但在我们解决任何问题之前，我们需要花时间去理解它。 考虑到这一点，我想首先分享一句中国谚语: "如果你的计划是一年，种植水稻。 如果你的计划是十年，那就种树吧。 如果你的计划是一百年，那就教育孩子吧。"这就是我们今天的目标。坚持一个近 70 年的梦想…。许多国家都有一个共同的梦想，那就是教育孩子，让他们变得更有创造力，成为批判性的思思考者，并追求一个有一天会带领他们的国家走向伟大的梦想。



Let me start by telling you a true story. Now it may not seem relevant at first, but I assure you it is. So, bear with me for just a moment.	让我先给你讲一个真实的故事。 现在一开始它可能看起来不相关，但我向你保证它是相关的。所以，请耐心等待我一下。



I want to start by sharing a story about my sister's path to becoming a success businesswoman. She graduated "Summa cum laude" in Finance & Economics from one of the best universities in the country and after graduating she applied for a job at the national headquarters for the largest fund companies in the country.

Now it was no surprise that she landed the interview, got the job, and started her 6-month training program with about 50 other successful applicants. However, she was surprised to find out she was the only person that was hired with a degree in finance and economics. So, she asked her heiring manager why the company didn't heir more people with relevant degrees and qualifications. And their response was that they intentionally avoid it!

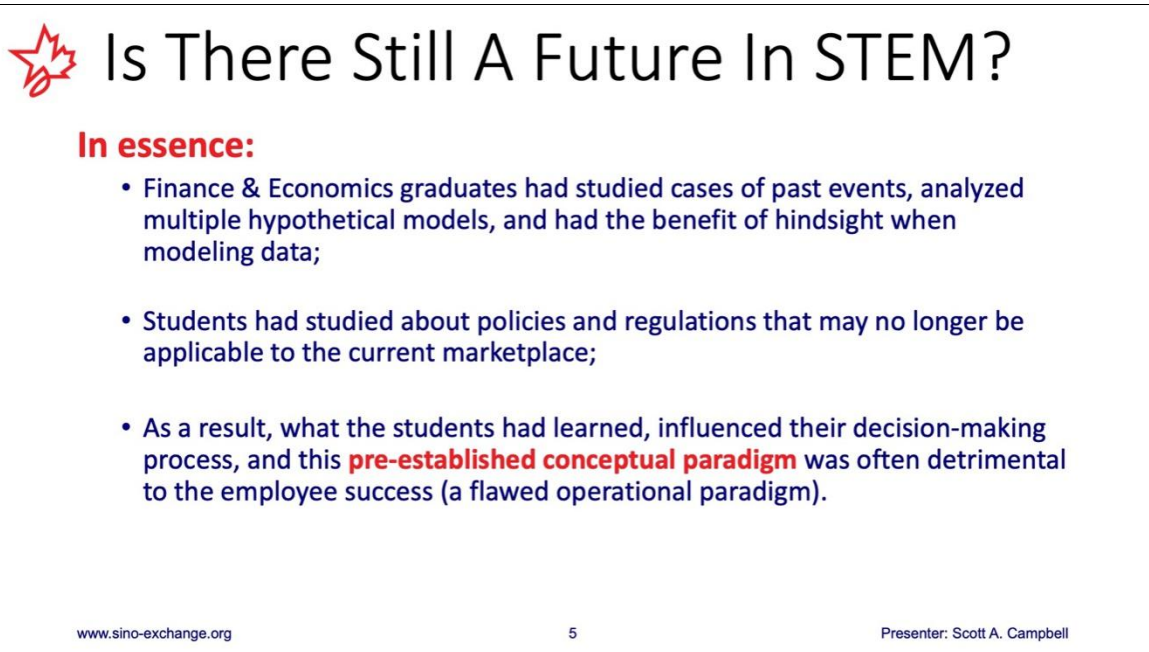
However, that might come as a big surprise to many of you!

首先，我想分享一个关于我姐姐成为成功女商人的故事。她以优异成绩毕业于美国最好的大学之一的财经专业，毕业后她申请了美国最大基金公司国家总部的工作。

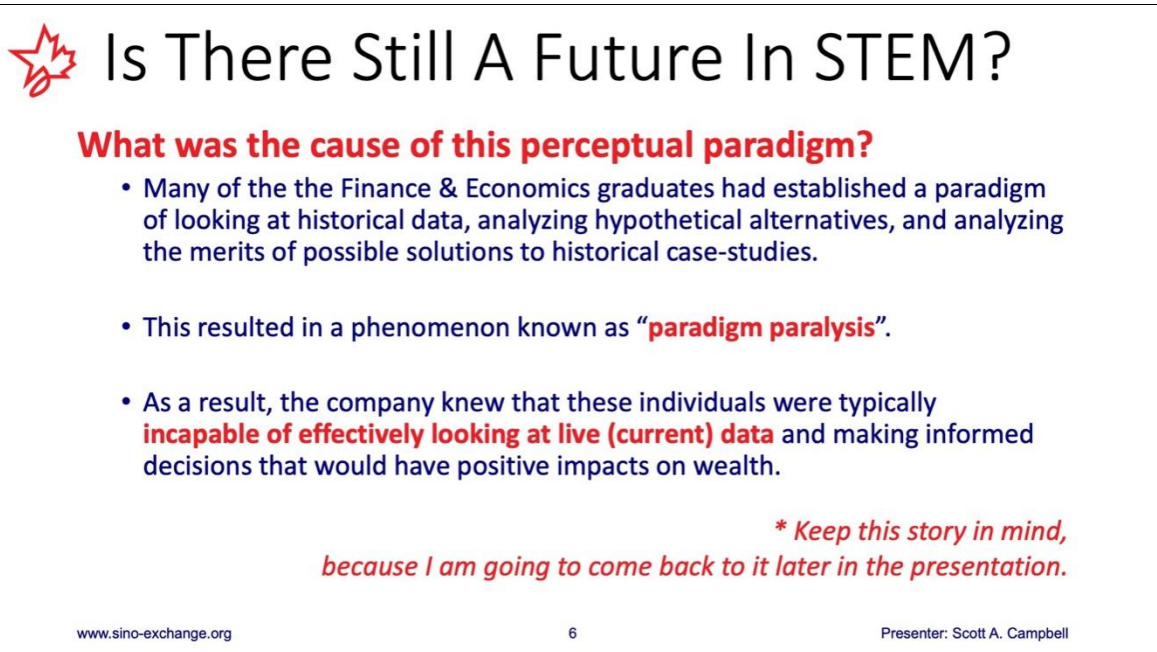
现在，她获得了面试机会，得到了这份工作，并与大约 50 名其他成功申请者一起开始了为期 6 个月的培训计划，这一点也不奇怪。然而，她惊讶地发现，她是唯一一个获得财经学位的人。因此，她问她的继承人经理，为什么公司没有招收更多具有相关学位和资格的人。他们的反应是故意回避!

然而，这可能会让你们中的许多人大吃一惊!

Now what is the moral of this story? Well, the company knew that everything the candidates had learnt was likely no longer relevant or applicable in the current operational paradigm of the modern finance market. Therefore, they needed to retrain the candidates regardless of what prior learning they already had.	这个故事的寓意是什么? 好吧，该公司知道，候选人所学到的一切在现代金融市场的当前运营模式中可能不再相关或适用。因此，他们需要对候选人进行再培训，不管他们之前已经学过什么。



In essence, Finance & Economics graduates learnt cases studies of past events, analyzed multiple hypothetical models, and had the benefit of hindsight when modeling data. Moreover, students had learnt about policy and regulations that may no longer be applicable to the current marketplace, and as a result, what the students had learnt influenced their decision-making process, and this pre-established conceptual paradigm was often detrimental to the employee success.	从本质上讲，财经专业的毕业生学习了过去事件的案例研究，分析了多个假设模型，并在建模数据时有后见之明。此外，学生们已经了解到可能不再适用于当前市场的政策和法规，因此，学生们所学到的知识影响了他们的决策过程，而这种预先建立的概念范式往往不利于员工的成功。



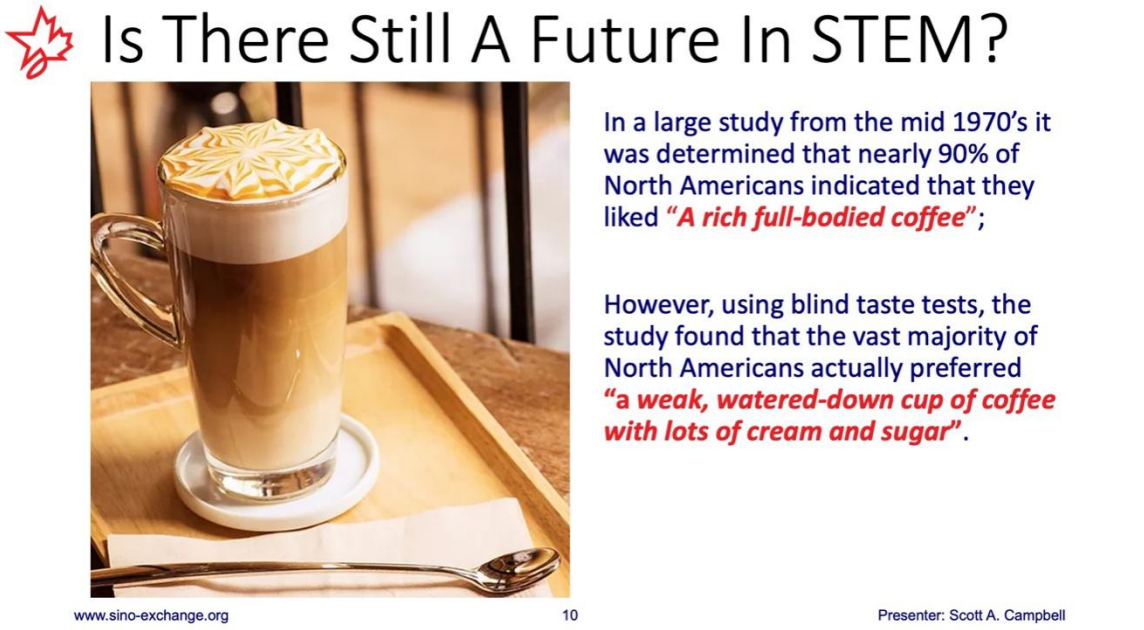
Now what was the cause of this perceptual paradigm? Well, so many graduates had established a paradigm of looking at historical data, analyzing hypothetical alternatives, and analyzing the merits of possible solutions to historical case-studies. This resulted in a phenomenon known as "paradigm paralysis", a term that was coined and popularized by Joel Baker. In this context these individuals were so used to looking at historical data in depth and formulating numerous hypothetical solutions that they ended up not being able to act on anything because they were essentially paralysed by indecision as they tried to explore numerous hypothetical solutions to the same problem. As a result, the company knew that these individuals were typically in-capable of effectively evaluating the live data. *Now I would like you to keep this story in mind, because I am going return to this idea later in the presentation.*	现在，是什么原因导致了这种感知范式? 好吧，这么多毕业生已经建立了一种范式，即查看历史数据，分析假设的替代方案，并分析历史案例研究的可能解决方案的优点。这导致了一种被称为"范式瘫痪"的现象，这个词是乔尔·贝克创造并推广的。在这种情况下，这些人太习惯于深入研究历史数据并制定许多假设的解决方案，以至于他们最终无法采取任何行动，因为他们在试图探索同一问题的许多假设解决方案时，基本上因犹豫不决而陷入瘫痪。 因此，公司知道这些人通常无法有效地评估实时数据。 现在我希望大家记住这个故事，因为我将在稍后的演示中回到这个想法。

So let's look at our agenda for today's presentation.	让我们来看看今天演讲的议程。
Now the first thing that we need to do is to develop a deeper understanding of our own thought processes. To do this we need to understand our own paradigms and how these paradigms shape our own understandings of the how we perceive things such as the world around us. Next, we need to analyze the true nature of STEM education so that we can go on and evaluate our own educational practices… And then we need to establish a series of actionable recommendations to help us start implement positive changes to the curriculum.	现在，我们需要做的第一件事是对我们自己的思维过程有更深入的理解。要做到这一点，我们需要理解我们自己的范式，以及这些范式如何塑造我们自己对周围世界等事物的理解，我们需要分析 STEM 教育的本质，以便继续评估我们自己的教育实践……然后我们需要制定一系列可行的建议，帮助我们开始对课程进行积极的变革。
So, these are the 4 big ideas that I am going to cover in this presentation.	因此，这是我将在本次演讲中介绍的 4 个重要想法。

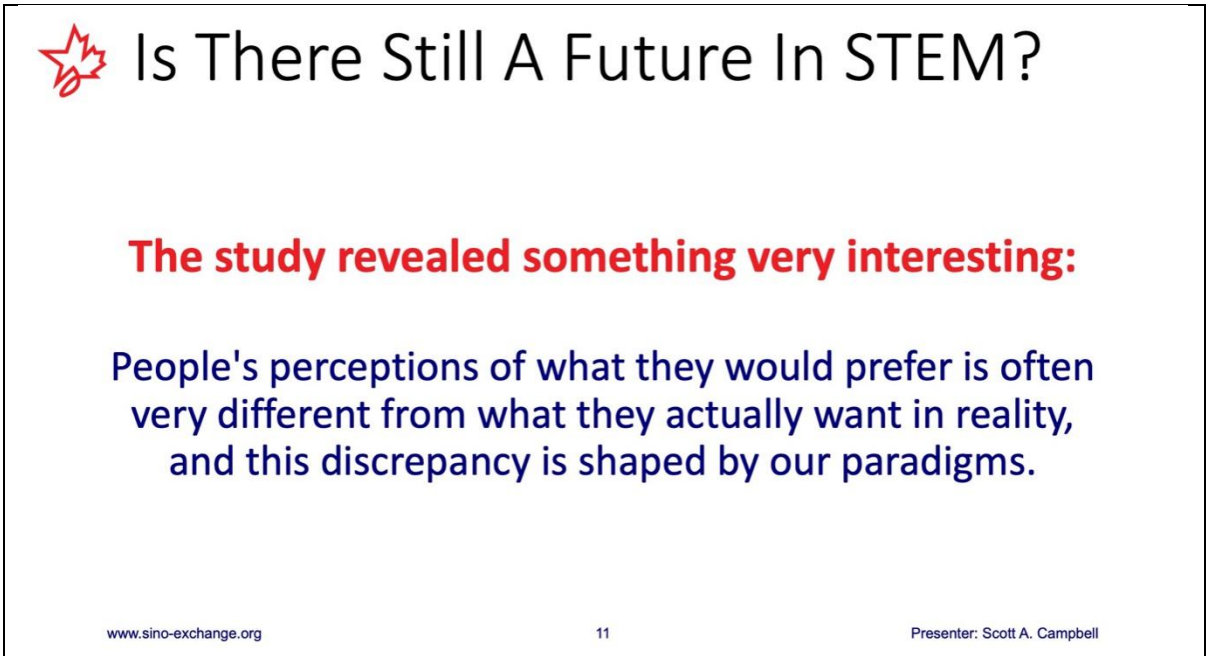
Understanding our own thought process… The very Theory of Knowledge, and how that affects our own understandings and perceptions is an incredibly complex concept. And clinical phycologist will spend their entire careers trying to answer these very questions. However, without getting into a huge philosophical debate… Our perceptions are like emotions in many ways! We can let our emotions control us, or we can be in control of our emptions… And the same holds true for our perceptions.	理解我们自己的思维过程……知识理论，以及它如何影响我们自己的理解和感知，是一个极其复杂的概念。 临床心理医生将在他们的整个职业生涯中努力回答这些问题。然而，如果不进入一场巨大的哲学辩论……我们的感知在很多方面都像情感！我们可以让我们的情绪控制我们，或者我们可以控制我们的欲望……这同样适用于我们的感知。
Now developing the self-awareness and discipline that is needed to be in control of our own thoughts is incredibly difficult… And we got a glimpse of that in the story I just shared with you…. but this idea also holds true for STEM education as well. Therefore, in a moment I continue to illustrate this idea through a series of guided examples that will help us understand the very nature of our own thought process… And I will also support these examples with proven scientific research.	现在，培养控制自己思想所需的自我意识和纪律是非常困难的… 在我刚刚与大家分享的故事中，我们看到了这一点…。但这一观点同样适用于 STEM 教育。因此，稍后我将继续通过一系列有指导意义的例子来说明这一观点，这些例子将帮助我们理解我们自己思维过程的本质……我也将通过经过验证的科学研究来支持这些例子。

Now the big idea here is to help us understand the very nature of our own thought process so that we can be in control of our own perceptions… And when that happens, our perceptions will no longer jeopardize the successful development of our STEM programs… Instead, they will become a positive driving factor for the development of quality STEM programs. So, if I had to summarize this idea… "People who are enslaved by their pre-established perceptions will never question the nature or validity of knowledge; however, those who question the very nature of their own assumptions will embark in an inquisitive journey of inquiry and critical thinking!" And that's the main idea that we want to develop and model through STEM education. So with that in mind, let's start with BIG IDEA # 1…. Understanding our own paradigms.	现在，这里的重要思想是帮助我们理解我们自己思维过程的本质，这样我们就可以控制自己的感知… 当这种情况发生时，我们的观念将不再危及我们 STEM 项目的成功发展… 相反，它们将成为开发高质量 STEM 项目的积极推动因素。 所以，如果我必须总结一下这个想法… "被预先建立的观念奴役的人永远不会质疑知识的性质或有效性；然而，那些质疑自己假设本质的人将开始一段探索和批判性思维的好奇之旅！"这是我们希望通过 STEM 教育发展和建模的主要理念。 因此，考虑到这一点，让我们从大创意 #1 开始…。理解我们自己的模式。

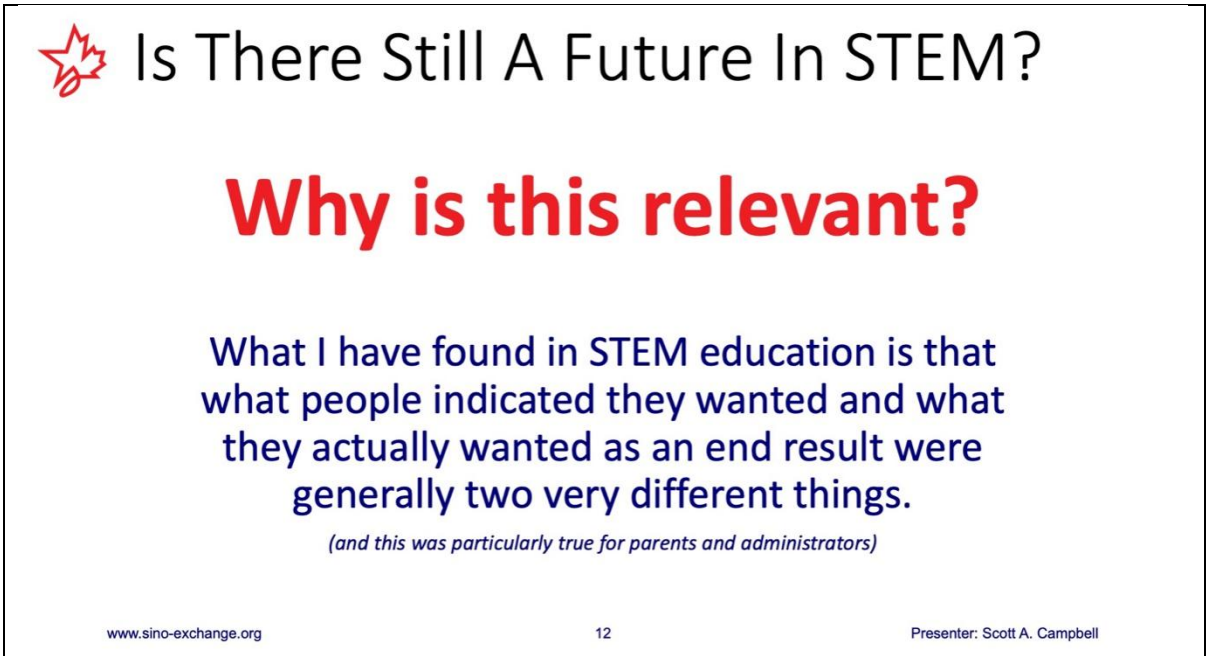
Now while everyone's coffee is still hot, I would like to ask you the following question… How many of you like a rich full-bodied coffee? Now it sounds quite nice, and if you are going to sit through a long presentation you will probably want a good cup of coffee with you right about now.	现在，趁着每个人的咖啡还热，我想问你们以下问题… 你们中有多少人喜欢浓郁的咖啡？现在听起来很不错，如果你要坐下来做一个长时间的演讲，你现在可能会想要一杯好咖啡。



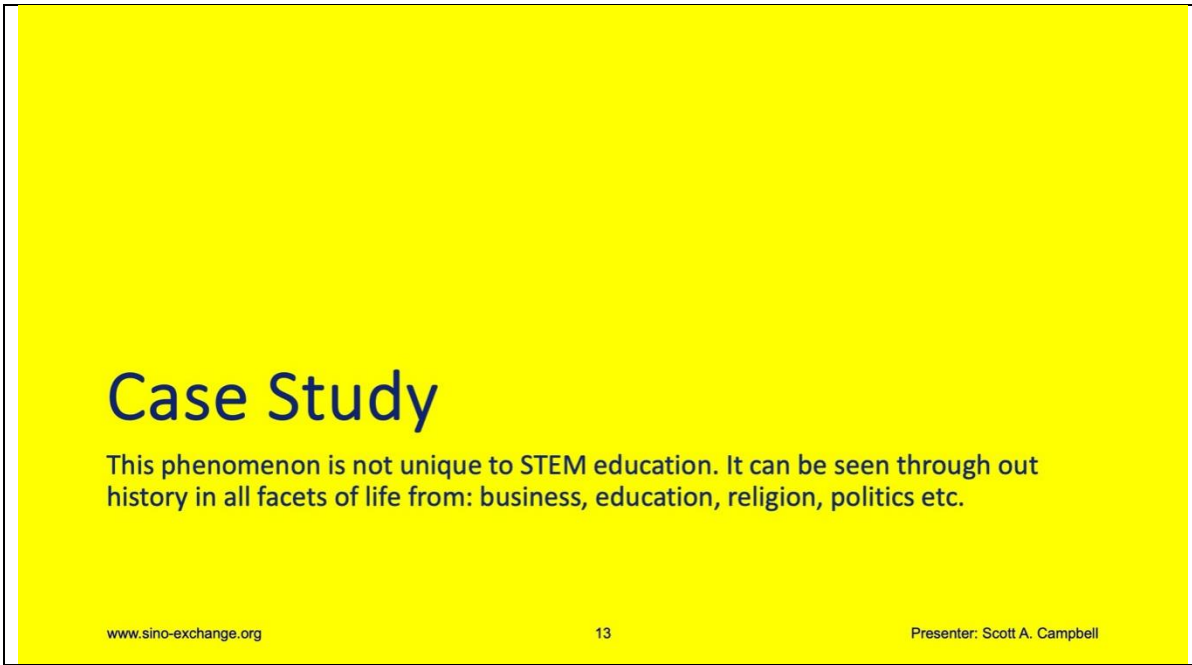
Now the reason why I asked you this is because I want to give you a real-life example of a paradigm. In the 1970's there was a large research study conducted in the Americas and it found that most Americans described themselves as liking a "***A rich full-bodied coffee***"; however, in contrast to what the participants believed, the study found that most Americans liked **"a *weak, watered-down cup of coffee with lots of cream and sugar"***.	我之所以问你这个问题，是因为我想给你一个现实生活中的范例。20 世纪 70 年代，有一项在美洲进行的大型研究发现，大多数美国人形容自己喜欢"浓郁的咖啡"；然而，与参与者的想法相反，研究发现，大多数美国人喜欢"一杯加了很多奶油和糖的淡咖啡"。



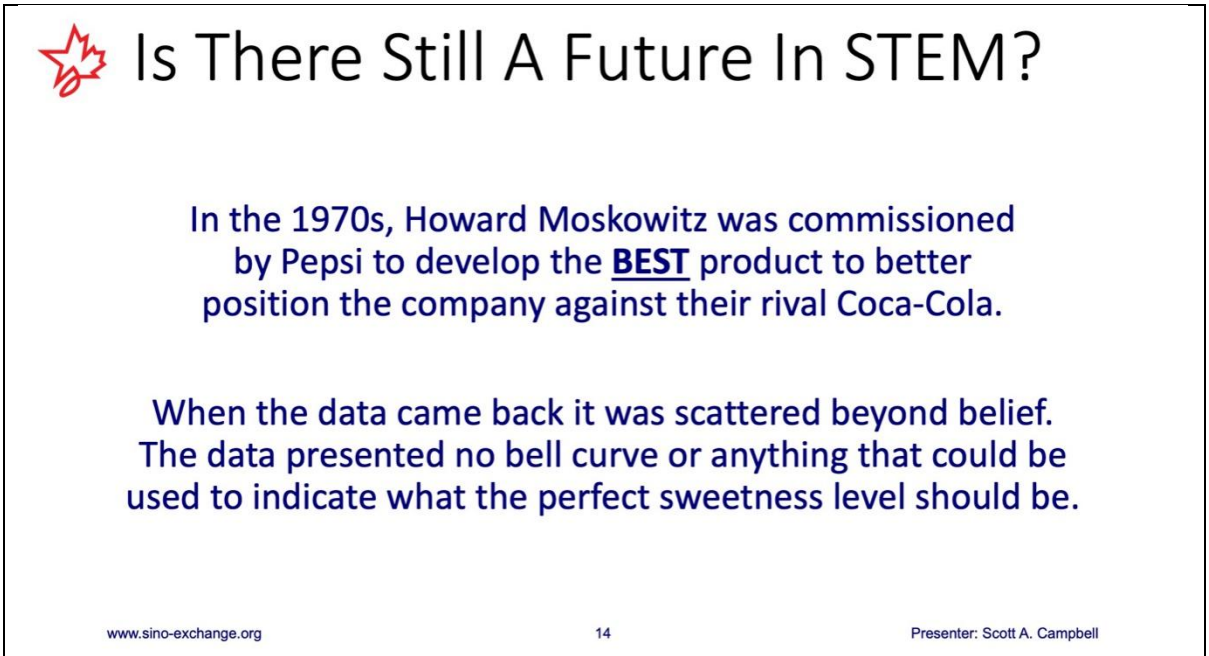
So, the study revealed something very interesting. People's perceptions of what they think they want is often very different from what they actually want in reality. And this discrepancy is shaped by our paradigms. Now telling somebody that you like a weak watery cup coffee with lots of cream and sugar goes against what we believe we should like. Whereas telling someone that you like a rich full-bodied coffee sound like what we should say we like, and most of the time we are not even aware that we are doing this. It's a completely subconscious response… And these kinds of dissociated responses are shaped by our paradigms.	因此，这项研究揭示了一些非常有趣的事情。人们对他们认为自己想要什么的看法往往与他们在现实中实际想要的非常不同。这种差异是由我们的思想模式造成的。 现在告诉别人你喜欢一杯加了很多奶油和糖的淡水咖啡，这与我们认为应该喜欢的背道而驰。而告诉别人你喜欢浓郁的咖啡听起来就像是我们应该说的，而且大多数时候我们甚至没有意识到我们在这样做。这完全是一种潜意识的反应……而这些游离的反应是由我们的思维模式塑造的。



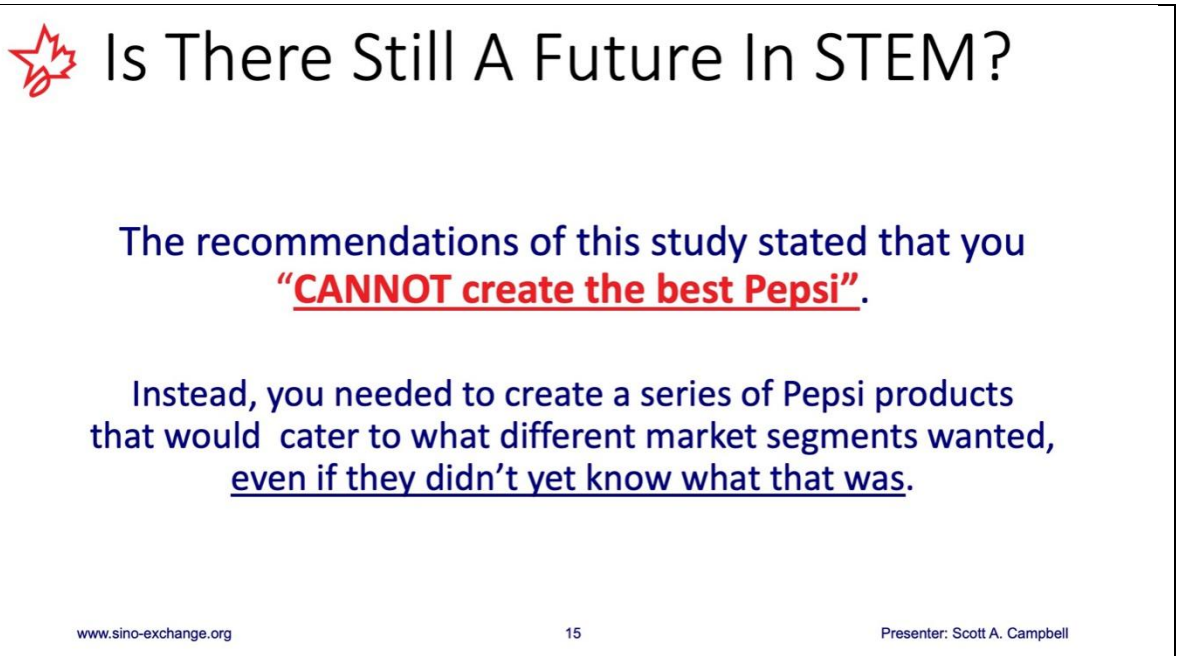
Now you may be asking why is this relevant? Well, what I have found in STEM education is that the reality of what people think they want, and what they actually want are generally 2 very different things, and this is particularly true of parents and administrators… And I will return to this idea later in the presentation.	现在你可能会问，为什么这是相关的? 好吧，我在 STEM 教育中发现，人们认为他们想要的现实和他们实际想要的通常是两种截然不同的东西，对于父母和管理人员来说尤其如此……我将在稍后的演讲中回到这个观点。



So let me give you some case studies… because this phenomenon is not unique. It happens throughout all aspects of life from business, education, religion, and politics! But the ideas are completely transferable! And they will help us understand the nature of our own assumptions, and that will help us when we move on to critically analyze our perceptions of STEM education.	所以让我给你一些案例研究…因为这种现象并不是独一无二的。它发生在生活的方方面面，从商业、教育、宗教到政治! 但这些想法是完全可以转移的！它们将帮助我们理解我们自己假设的本质，这将有助于我们继续批判性地分析我们对 STEM 教育的看法。



In the 1970's Howard Moskowitz was commissioned by Pepsi to develop the best product. Now when the data came in it was scattered beyond belief. There was no bell curve that could be used to indicate what the best product should be.	在 20 世纪 70 年代，霍华德·莫斯科维茨受百事可乐公司委托开发最好的产品。当数据来的时候，它分散得令人难以置信。没有钟形曲线可以用来指示什么是最好的产品。

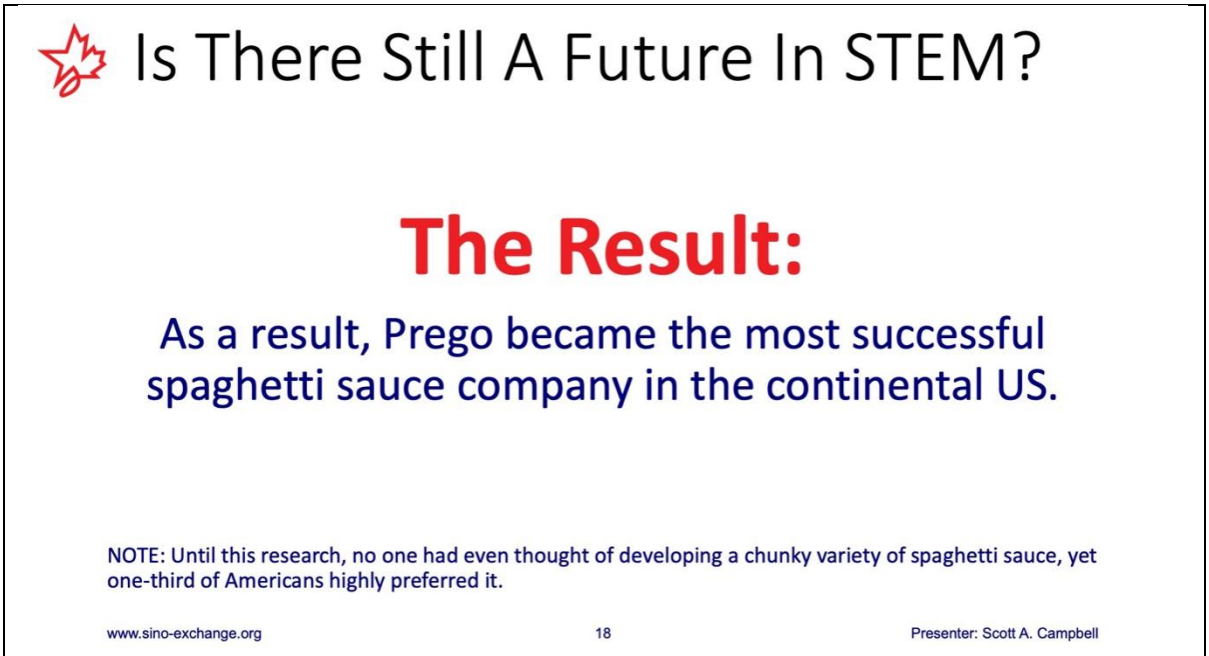


Now the recommendations that were made by Moskovitz at the time were as follows: You **CAN NOT**… And I repeated, "**You CAN NOT make the best Pepsi!**" Instead, you need to create a serries Pepsi products that would cater to different market segments. Even if they didn't even know what they wanted yet themselves. Now this idea was unheard of at the time… So, Pepsi rejected the finding because it went against everything their past successes had taught them. It went against their established paradigm!	莫斯科维茨当时提出的建议如下: 你不能……我重复道，"你不能做最好的百事可乐！"相反，你需要创造一系列百事可乐产品，以迎合不同的细分市场。即使他们自己都不知道自己想要什么。 现在这个想法在当时是闻所未闻的… 因此，百事公司拒绝接受这一发现，因为这与他们过去的成功经验背道而驰。这违背了他们的既定模式!

Now I would like to fast forward a few years in time. Moskowitz then goes on to take his revelation to Prego, who at the time had limited market share in the United States. Now in his studies for Pergo, Moskowitz experiment with 45 different types of spaghettis, and he found that…	现在我想让时间快进几年。莫斯科维茨把他的发现告诉了 Prego，当时 Prego 在美国的市场份额有限。 在他为 Pergo 做的研究中，莫斯科维茨用 45 种不同类型的意大利面进行了实验，他发现…

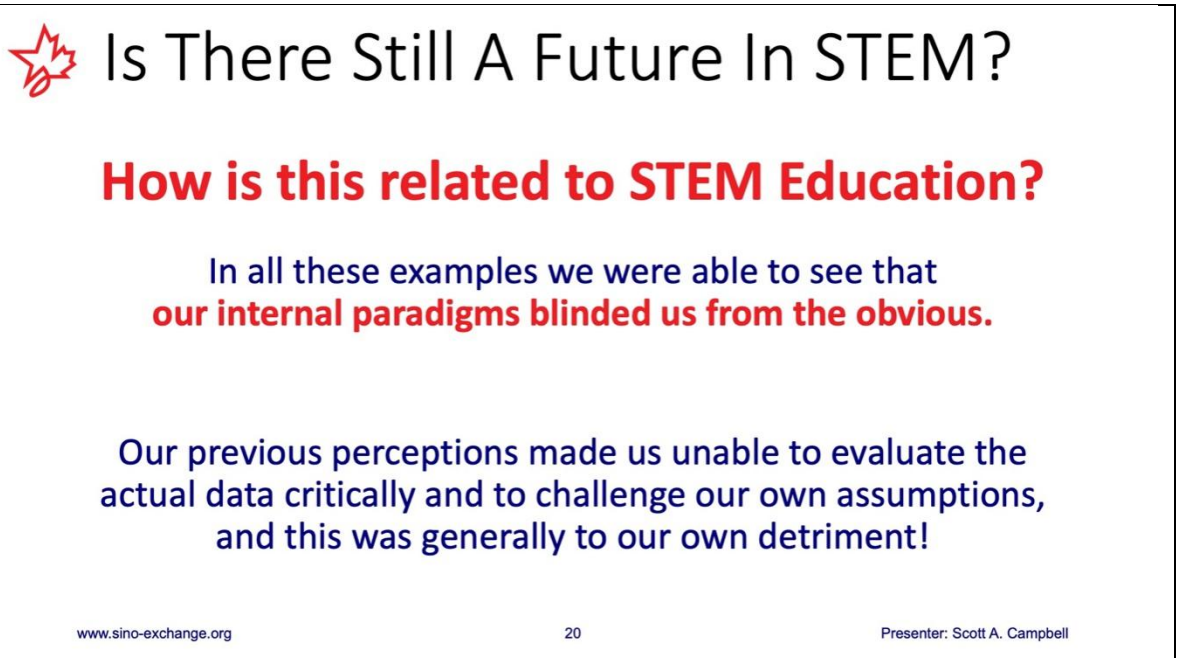
People generally fell into 3 categories: 1. Those who liked a plain spaghetti sauce, 2. Those who liked a chunky spaghetti sauce, 3. And those who liked a spicy spaghetti sauce.	人们通常分为三类： 1.那些喜欢普通意大利面酱的人， 2.那些喜欢浓稠意大利面酱的人， 3.还有喜欢辣味意大利面酱的人。
Again, this research study revealed that most people did not even know that they liked, until they were given the opportunity to challenge their own assumptions, and this was because they were caught in a particular paradigm.	同样，这项研究表明，大多数人甚至不知道自己喜欢什么，直到他们有机会挑战自己的假设。这是因为他们陷入了一种特殊的思考模式。
But what caused this conceptual paradigm in the first place? Well, most people at the time believed that they should like a traditional Italian spaghetti sauce! Because, admitting that you like something that wasn't authentic just didn't sound right. However, the reality of the fact was that most American's palate was very different than the average European. So again, we see that people's perceptions are very different from reality and this discrepancy has been shaped by our paradigms, but before this time business and customers alike were not aware of this phenomenon!	但是，最初是什么导致了这种概念范式？嗯，当时大多数人都认为他们应该喜欢传统的意大利意大利面条酱！因为，承认你喜欢一些不真实的东西听起来是不对的。然而，事实是，大多数美国人的味觉与普通欧洲人截然不同。因此，我们再次看到，人们的看法与现实非常不同，这种差异是由我们的思维模式形成的，但在此之前，企业和客户都没有意识到这种现象！

As a result, companies were not innovating because they were trapped in this idea of "business as usual", and "this is how things have always been done". Moreover, customers didn't even know what they liked until they were given the opportunity to explore different product offerings for themselves. And as we saw with Pepsi…. They only wanted to look at how to make the best singular Pepsi product rather than looking at ways to innovate. And why was that? Because the obvious solution was different than what they had always done. It went against their established paradigms! And this made them incapable of perceiving the data that was presented to them by Moskowitz.	因此，公司没有创新，因为他们被困在"一切照常"的想法中，"事情总是这样做的"。此外，客户甚至不知道自己喜欢什么，直到有机会为自己探索不同的产品。正如我们在百事可乐上看到的那样…。他们只想看看如何制造出最好的百事产品，而不是寻找创新的方法。 为什么会这样？因为显而易见的解决方案与他们一贯的做法不同。这违背了他们既定的模式！这使他们无法理解莫斯科维茨提供给他们的数据。

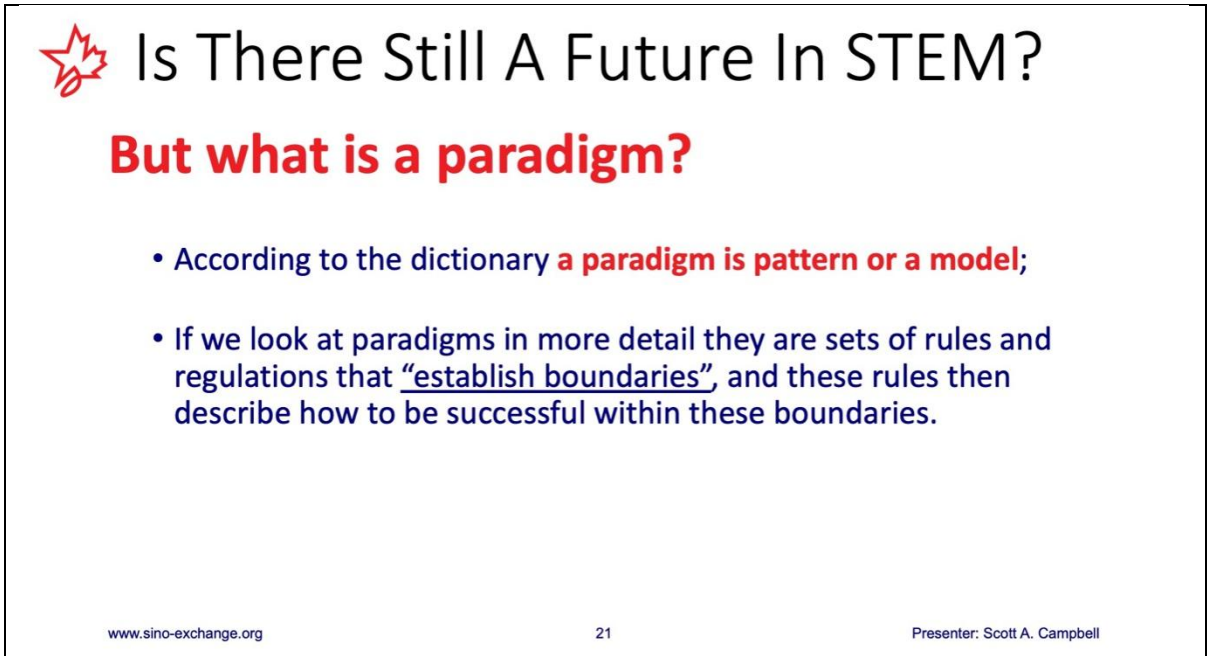


So, what was the result of this study? Well Prego went on to become the most successful spaghetti sauce in the Continental United States, and this was because they acted on the research that was presented to them! And finally, they tried something that no one else had ever done before. Now in hindsight the idea of creating different product offerings to cater to different market segments seams incredibly obvious now, but this was a completely new and novel idea at the time.	那么，这项研究的结果是什么呢? 普雷戈后来成为美国大陆最成功的意大利面酱，这是因为他们对提交给他们的研究采取了行动！最后，他们尝试了其他人从未做过的事情。 现在回过头来看，创造不同产品来迎合不同细分市场的想法现在非常明显，但这在当时是一个全新的想法。

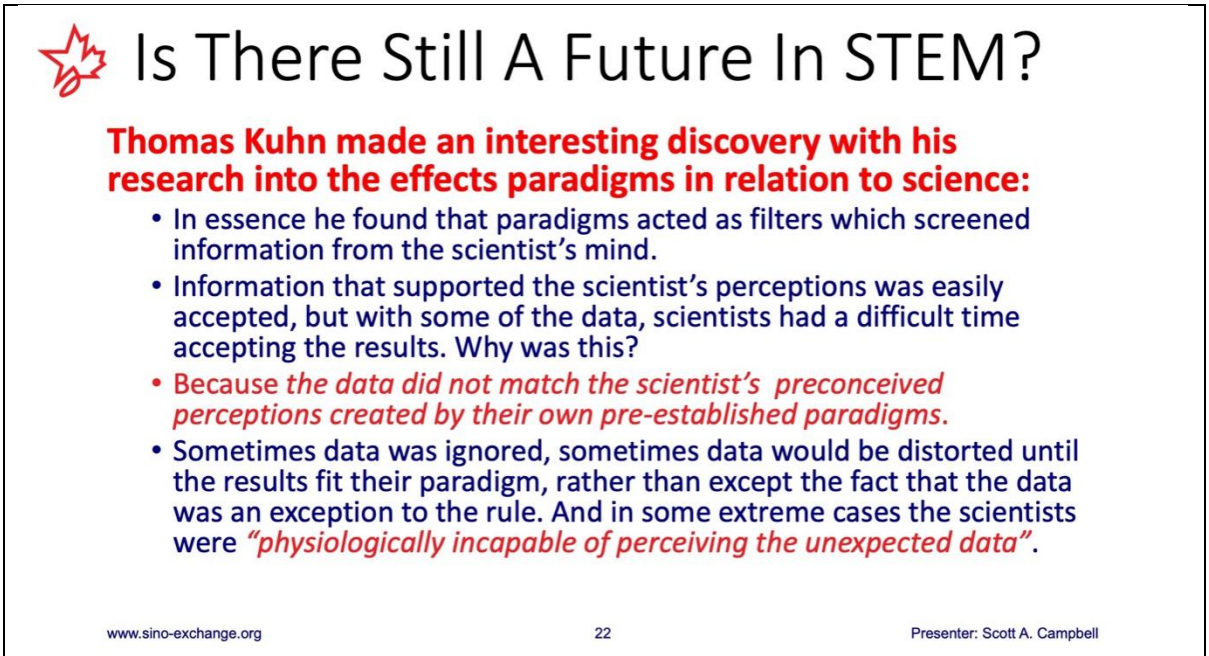
Now you might ask… What happened to Pepsi? Well after witnessing the success of Prego, Pepsi made a few changes. In 1977 they hired John Sculley. In 1978 they started experimenting with new flavors, and in1980 Pepsi goes on to capture the number one spot in sales. So, it took a while to recognize and understand their mistake. Afterall, they were unable to conceptualize the recommendations that were made to them many years earlier… And why was this? Because the data didn't fit into their perceptional paradigm of how a business should be run.	现在你可能会问…百事可乐怎么了？在见证了普雷戈的成功之后，百事做出了一些改变。 1977 年，他们雇佣了约翰·斯库利。1978 年，他们开始尝试新口味，1980 年百事可乐继续占据销量第一的位置。因此，我们花了一段时间才认识到并理解他们的错误。 毕竟，他们无法将多年前向他们提出的建议概念化……为什么会这样？因为这些数据不符合他们对企业应该如何运营的认知模式。



Now you might be asking yourself "how is this related to STEM education?"	现在你可能会问自己"这与 STEM 教育有什么关系？"
As these examples illustrate most people's perceptions of what they think they want and what they actually want are two very disassociated concepts, and this holds true to our perceptions of STEM education as well. Our entire perception of STEM is shaped by our paradigms, and as we have seen, paradigms can blind us from the truth! Furthermore, we all have very different pre-established paradigms, and that makes it very difficult for us to develop a common language and understanding of STEM education.	正如这些例子所表明的那样，大多数人对他们认为自己想要什么和实际想要什么的看法是两个非常没有关联的概念，这也适用于我们对 STEM 教育的看法。我们对 STEM 的整个认知是由我们的思维模式塑造的，正如我们所看到的，范式会让我们视而不见！此外，我们都有非常不同的预先建立的范式，这使得我们很难发展对 STEM 教育的共同语言和理解。
As a result, we often see that there is a lot of confusion surrounding STEM, and that is one thing I hope to alleviate by the end of this presentation. Therefore, to address this issue, we need to develop some common language and understandings of STEM education before moving on.	因此，我们经常看到围绕 STEM 有很多困惑，这是我希望在本演讲结束时减轻的一件事。因此，为了解决这个问题，我们需要在继续前进之前发展一些对 STEM 教育的共同语言和理解。



But let's talk about what paradigm is, because I have been using this word a lot. Now according to the dictionary, a paradigm is a pattern or a model. And this definition doesn't give us a lot of information! But if we look at it in more detail… According to Joel Baker, paradigms essentially establish boundaries, which a pattern does! They also gone on to tell us how to be successful within the boundaries of a given model. Now with this in mind, I would also like to quickly review a research study that was conducted by Thomas Kuhn who researched the effect of paradigms in science.	但让我们来谈谈什么是范式，因为我经常用了很多次这个词。 根据字典的说法，范式是一种模式或模型。 这个定义并没有给我们很多信息！但如果我们更详细地看… 根据乔尔·贝克的说法，范式本质上是建立边界的，而模式就是这样！他们还告诉我们如何在给定模型的范围内取得成功。 考虑到这一点，我也想快速回顾一下托马斯·库恩进行的一项研究，他研究了范式在科学中的作用。



Now Kuhn made an interesting discovery. In essence he found that paradigms acted as filters that screened information from the scientist's mind.	现在库恩有了一个有趣的发现。从本质上讲，他发现范式起到了过滤科学家头脑中信息的作用。
Information that supported the scientist's perceptions was easily accepted, while information that conflicted with scientist's perceptions was often ignored. And why was this? Because the data did not match the individual's pre-established paradigms	支持科学家感知的信息很容易被接受，而与科学家感知相冲突的信息往往被忽视。为什么会这样？因为数据与个人预先建立的范式不匹配。
Now sometimes the data would be ignored, sometimes it was manipulated to fit within what was expected, and sometimes…. **And I quote *"the scientists were physiologically incapable of perceiving the unexpected data"*** *and we saw this with Pepsi.* They were unable to accept data that was presented to them because it went against their paradigms. Essentially the board of directors was "***physiologically incapable***" of accepting the new data, analyzing it, and drawing conclusions for themselves, because the data that they were presented with did not fit into their pre-existing conceptual paradigm.	现在有时数据会被忽略，有时会被操纵以符合预期，有时…。 我引用了"科学家们在生理上无法感知意外的数据"，我们在百事可乐身上看到了这一点。他们无法接受提交给他们的数据，因为这违背了他们的范式。 从本质上讲，董事会"在生理上没有能力"接受新数据，对其进行分析，并自行得出结论，因为他们所获得的数据不符合他们预先存在的概念范式。

And this happens with STEM education as well. Our paradigms often prevent us from taking a moment analyze and evaluate our own assumptions, and as a result, we become trapped within “the established” boundaries of our paradigm.	STEM 教育也是如此。我们的范式经常阻止我们花时间分析和评估自己的假设，因此，我们被困在范式的“既定”边界内。
We never question the nature of our own thoughts, and this is important for us to do as teachers as we need to question the nature of our own knowledge. But more importantly, we need to move beyond a rudimentary knowledge of what STEM so that we can develop a deeper understanding of true nature STEM education by questioning our assumptions by challenging our pre-established paradigms.	我们从不质疑自己思想的本质，这对我们作为教师来说很重要，因为我们需要质疑自己知识的本质。但更重要的是，我们需要超越 STEM 的基本知识，通过质疑我们的假设和挑战我们预先建立的范式，我们才能更深入地理解 STEM 教育的真实本质。

And that brings us to BIG IDEA #2 where I would like to develop a shared paradigm of STEM education with you. Now so far, I've warned about the dangers of paradigms, and now I'm saying that we need to develop a shared paradigm. But what we want to do here is to develop a shared understanding of STEM education in-which we can use develop our discussions. But more importantly, we want to build a common framework in-which we can use to critically reflect upon and analyze our own assumptions. And I want to emphasize those keywords again: "critically reflect" and "analyze" our own assumptions. Afterall, in the previous examples we've seen the dangers that pre-established paradigms can have when people allow their preconceptions to control their thought process. Therefore, we need to develop a culture of life-long-learning, that will foster inquiry and critical thinking… so that we constantly question the very nature of our own assumptions. To challenge and validate the integrity of our own perceptions, and that's the reason why	这就把我们带到了第二个大创意，我想和你们一起开发一个共享的 STEM 教育模式。 到目前为止，我已经警告过范式的危险，现在我要说的是，我们需要发展一个共享的范式。 但我们在这里想做的是发展对 STEM 教育的共同理解，我们可以在其中进行讨论。但更重要的是，我们希望建立一个共同的框架，在这个框架中，我们可以批判性地反思和分析我们自己的假设。 我想再次强调这些关键词："批判性地反思"和"分析"我们自己的假设。 毕竟，在前面的例子中，我们已经看到了当人们允许他们的先入为主的观念控制他们的思维过程时，预先建立的范式可能会带来的危险。因此，我们需要培养一种终身学习的文化，培养探究和批判性思维… 因此，我们不断质疑自己假设的本质。挑战和验证我们自己感知的完整性，这就是我们想要发展 STEM 教育的共同感知范式的原因。

we want to develop a common perceptual paradigm of STEM education. It isn't to tell you want to think, but to help you think about how you think. Therefore, we want to develop a paradigm of critical thinking and analysis, and not a paradigm of ignorance, complacency, and blind acceptance!	这不是告诉你想思考，而是帮助你思考自己的想法。因此，我们希望发展一种批判性思维和分析的范式，而不是无知、自满和盲目接受的范式!

So, let's talk about STEM! But more importantly, what is STEM education?	那么，让我们来谈谈 STEM 吧！但更重要的是，什么是 STEM 教育？

Now to answer this question we do need to review our own history. We need to understand where STEM came from and why it's important in the first place.	现在，为了回答这个问题，我们确实需要回顾一下我们自己的历史。我们首先需要了解 STEM 的来源以及为什么它很重要。

While the acronym for STEM would not exist for many years, the events that lead to its creation are as follows:

On October 4th, 1957, Sputnik 1 was launched into space, and this event initiated a space race between the Soviet Union and the United States.

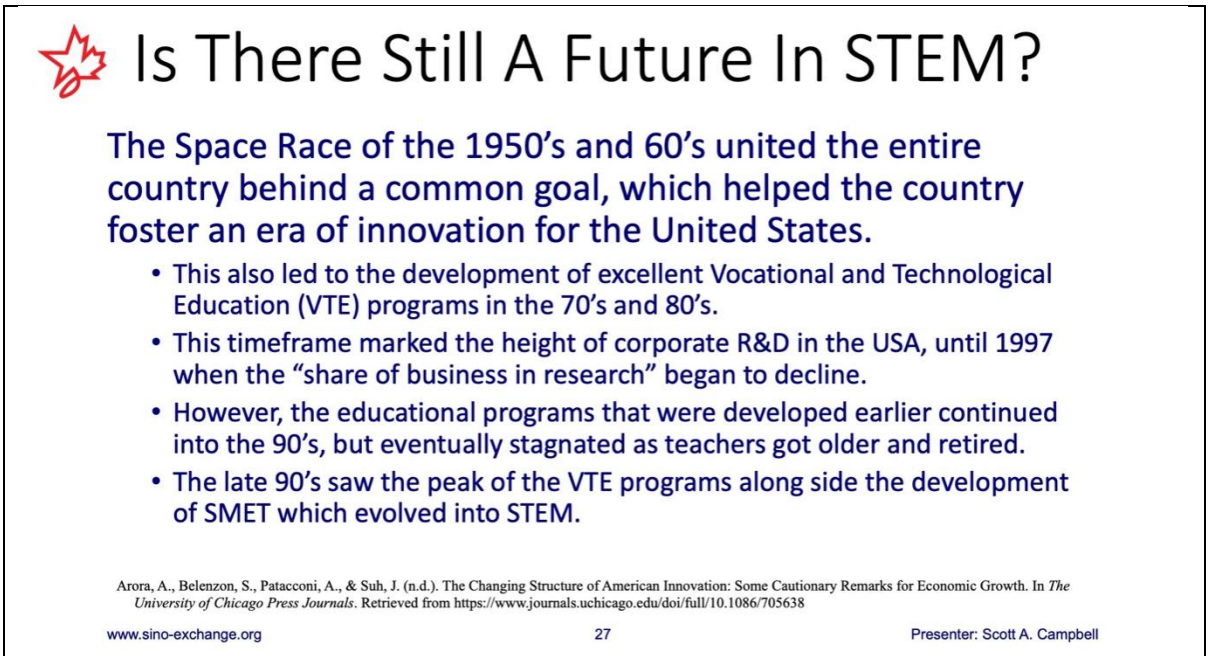
Now during early years of space exploration, the Soviet Union did initially dominate the space race, and I could cite numerous examples; However, through perseverance, the United States would eventually surpass the Russian Federation. And this happened on July 20th, 1969, when Neil Armstrong and Buzz Aldrin became the first men to walk on the moon.
However, you can see that it took 12 years for the Americans to really catch up and surpass the Russians. Now innovation in space travel did slow to some extent after that but we did still see it continue. And in 1998 we saw the launch of the first module of the International Space Station were different nations starting to collaborate in space for the very first time, and you also started to see the idea of STEM taking hold internationally at this point as well.

虽然 STEM 的首字母缩写在很多年内都不存在，但导致其创建的事件如下：

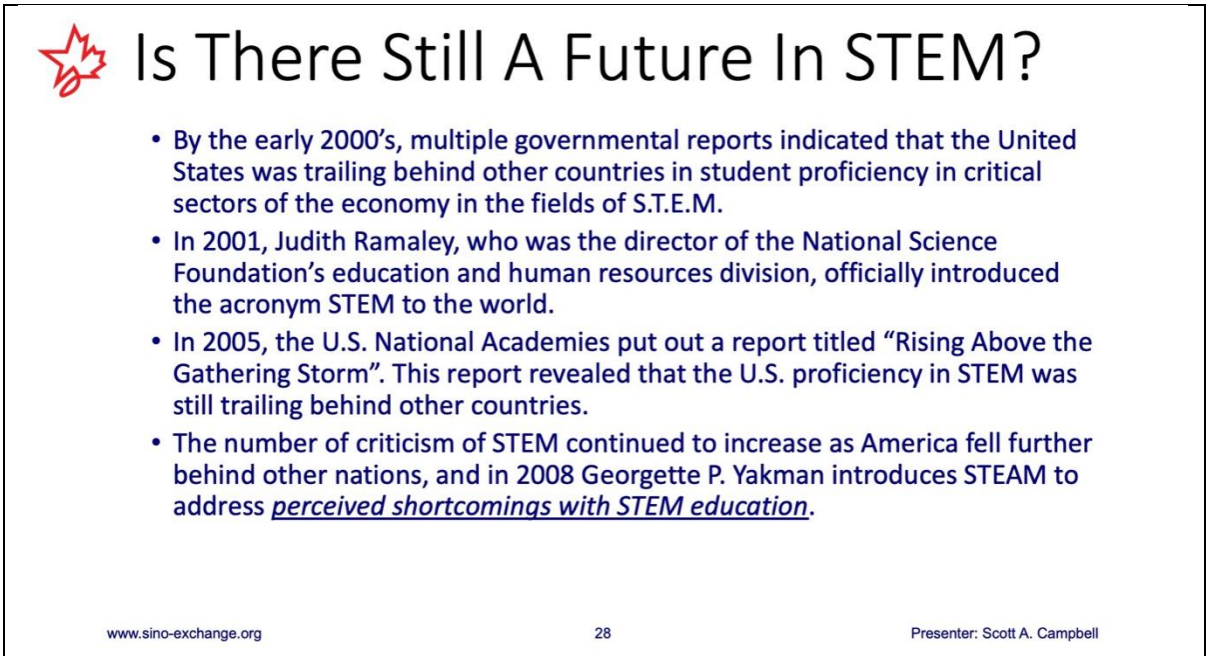
1957 年 10 月 4 日，人造卫星 1 号被发射到太空，这一事件引发了苏联和美国之间的太空竞赛。

现在，在太空探索的最初几年，苏联确实在太空竞赛中占据了主导地位，我可以举出许多例子；然而，通过坚持不懈，美国最终将超过俄罗斯联邦。1969 年 7 月 20 日，尼尔·阿姆斯特朗和巴兹·奥尔德林成为第一批登上月球的人。然而，你可以看到，美国人花了 12 年的时间才真正赶上并超过俄罗斯人。现在，太空旅行的创新在那之后确实有所放缓，但我们仍然看到它在继续。1998 年，我们看到国际空间站第一个模块的发射，不同的国家第一次开始在太空合作。在这一点上，你也开始看到 STEM 在国际上站稳脚跟的想法。

Therefore, the impacts that the space race had on education was profound because it sparked our curiosity and fueled our ingenuity! And you will see the effects of this point in history resonate for decades to come.	因此，太空竞赛对教育的影响是深远的，因为它激发了我们的好奇心，激发了我们创造力！你们会看到，这一历史时刻的影响将在未来几十年产生共鸣。

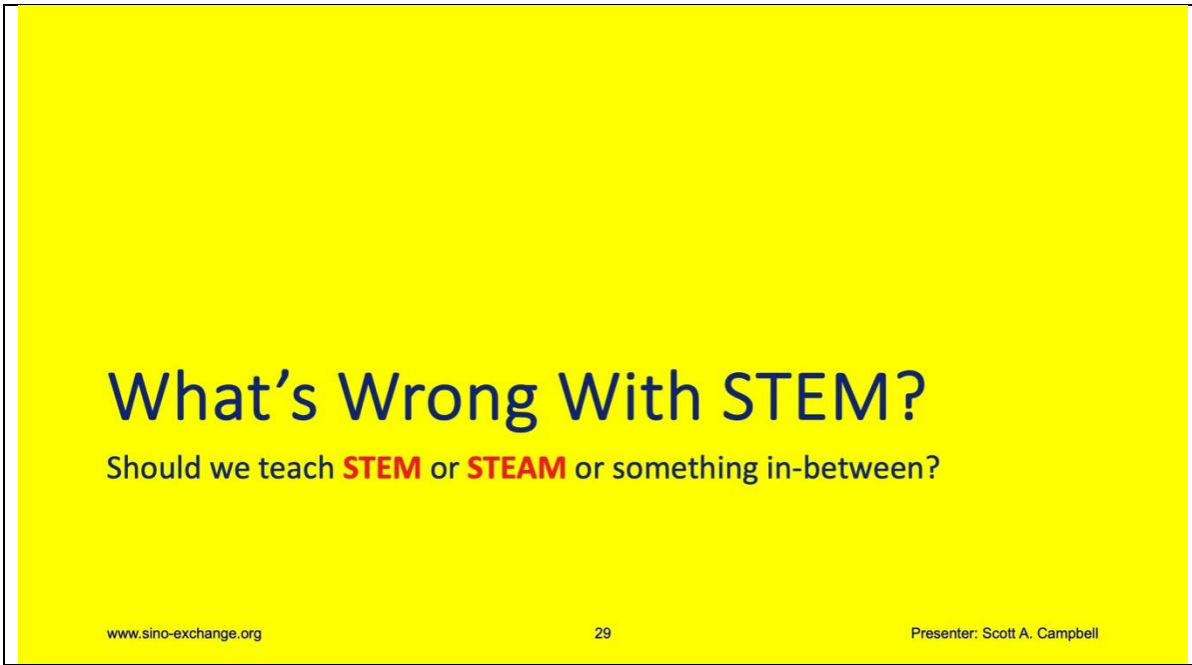


Now the space race of the 1950's and 60's essentially united the country behind a common goal, and this led to the development of excellent Vocational and Technological Education programs or VTE for short in the 1970's and 80's. Now this timeframe also marked the height of corporate R&D in the US as well… Until 1997 when the share of business research started to decline. This was also coupled the fact that many teachers who were part of this initial wave of educational innovation were also approaching retirement age. Now the VTE programs did continue well into the 90's when they reached their zenith, before starting to decline, and this was also about the same time that corporate research in the US also started to decline as well. Now these 2 issues are completely unrelated to one another, but they will have a compounding effect on the US economy, innovation, and education. As a result, the economy and many VTE programs peaked in the late 1990's!	现在，20 世纪 50 年代和 60 年代的太空竞赛基本上将国家团结在一个共同的目标后面，这导致了 20 世纪 70 年代和 80 年代优秀的职业技术教育项目（简称 VTE）的发展。 现在，这一时间段也标志着美国企业研发的高度……直到 1997 年，商业研究的份额开始下降。 此外，许多参与这一波教育创新的教师也接近退休年龄。现在，VTE 项目确实一直持续到 90 年代，当时它们达到了顶峰，然后开始衰落，而这也是美国企业研究也开始衰落的同时。 现在，这两个问题彼此完全无关，但它们将对美国经济、创新和教育产生复合效应。 因此，经济和许多 VTE 项目在 20 世纪 90 年代末达到了顶峰！

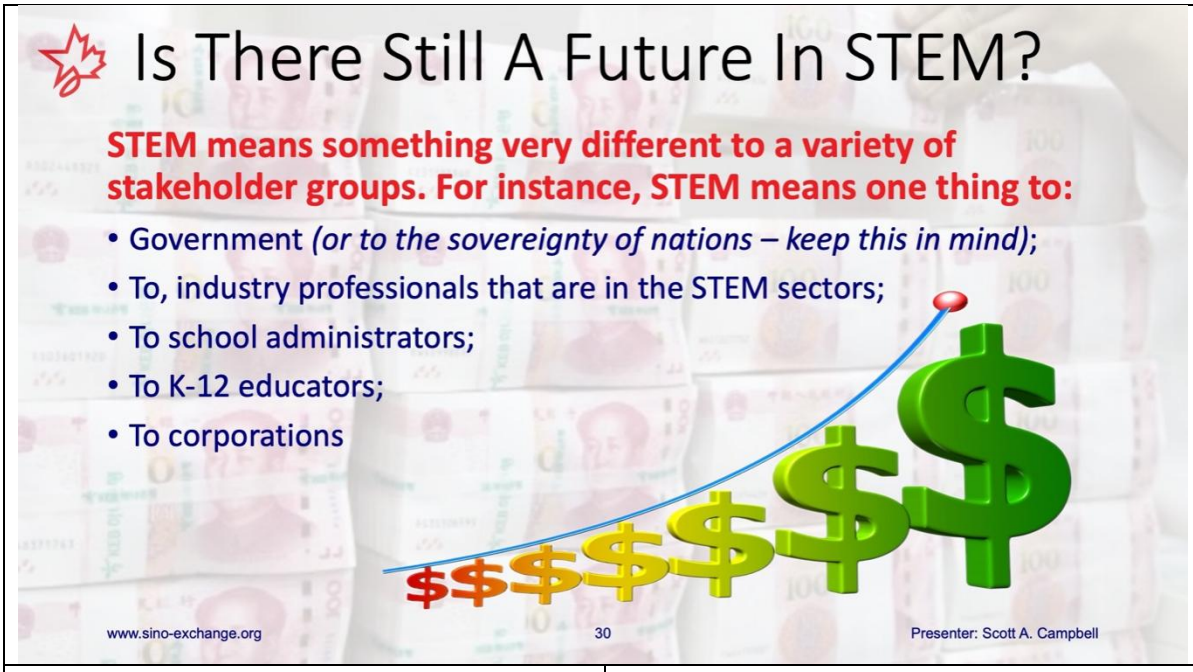


So, by the late 1990's many VTE programs that schools offered were starting to stagnate, teachers were approaching retirement, and business were not conducting as much R&D as they had done in previous decades, and all these factors would put into motion a series of events that would have a profound effect on the US economy, and subsequently education.	因此，到了 20 世纪 90 年代末，学校提供的许多 VTE 项目开始停滞，教师即将退休，企业也没有像前几十年那样进行那么多的研发，所有这些因素都会引发一系列事件，对美国经济和随后的教育产生深远影响。
By the turn of the century multiple government reports were indicating the United States was falling behind in sectors that were critical to the economy… **Now not to state the obvious, but the fact that students in the US were trailing in these sectors was bad for the economy!** And this really illustrates the idea that the goal with STEM education was to ensure that the nation would continue being a global leader in innovation. So, it really comes down to the need of any country to protect its own economic interests, and more importantly… to protect its own national sovereignty.	到本世纪之交，多份政府报告表明，美国在对经济至关重要的领域落后了…现在不说显而易见的事情，但美国学生在这些行业落后的事实对经济不利！这确实说明了 STEM 教育的目标是确保国家继续成为创新的全球领导者。因此，归根结底，任何国家都需要保护自己的经济利益，更重要的是……保护自己的国家主权。
Therefore, in 2001 Judith Ramaley formally introduce the acronym that we know today! Now I would argue that "STEM" was really just an extension of the VTE programs of	因此，Judith Ramaley 在 2001 年正式推出了我们今天所知道的首字母缩略词！现在我认为，"STEM"实际上只是 20 世纪 70 年代至 90 年代 VTE 项目的延伸；然

the 1970's though the 90's; however, there's was one big difference. Vocational programs ranged in nature. Some were aligned to the development of job skills for a general labor, while others geared towards critical sectors in the economy such as: civil, computer, and electrical engineering. As such, STEM was not all encompassing of the VTE program offerings. Instead, it took the best of what those programs had to offer. And when I say the best, I mean the attainment of rigors academic learning outcomes and standards, and as a result, aspects of Project Based Learning were popularized and brought into mainstream education.	而，有一个很大的区别。职业项目性质各异。其中一些与普通劳动力的工作技能发展相一致，而另一些则面向经济中的关键部门，如：土木、计算机和电气工程。因此，STEM 并不是 VTE 课程的全部内容。相反，它利用了这些项目所能提供的最好的东西。当我说最好的时候，我指的是达到严格的学术学习成果和标准，因此，基于项目的学习被普及并纳入主流教育。
However, by 2005 another report came which revealing that the student in the United States were still falling further behind other nations, and this wasn't what we wanted to see. Now only 4 years had passed since STEM was introduced, and that is not enough time to see the effects of a long-term strategic policy; however, people are often very impatient, and they started criticizing the STEM framework because it wasn't producing results. More specificity it wasn't producing results as fast as what they wanted!	然而，到 2005 年，另一份报告显示，美国的学生仍然远远落后于其他国家，这不是我们希望看到的。现在，STEM 推出仅 4 年，这还不足以看到长期战略政策的效果；然而，人们往往非常不耐烦，他们开始批评 STEM 框架，因为它没有产生结果。更具体地说，它并没有像他们想要的那样快速产生结果！
Then in 2008 Georgette Yakman introduced STEM derivative that she called STEAM to address a number of perceived shortcomings in STEM education, **and I really want to reiterate this notion of "perceived shortcomings" with STEM….**	2008 年，Georgette Yakman 推出了 STEM 衍生产品，她称之为 STEAM，以解决 STEM 教育中的一些明显缺陷，我真的想重申 STEM"明显缺陷"的概念…

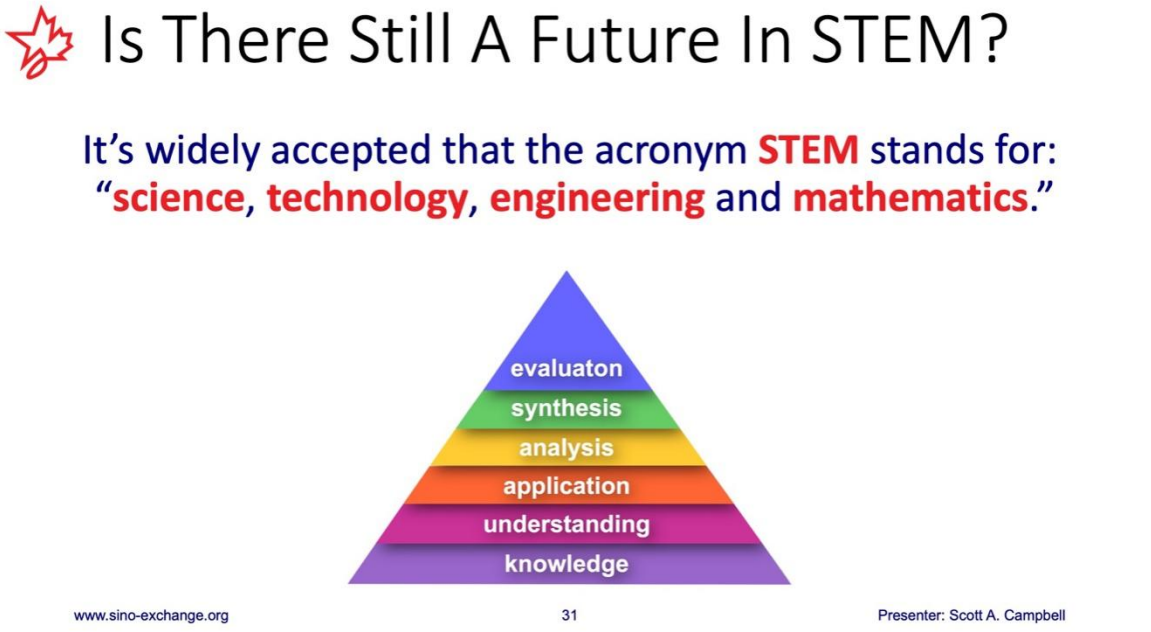


So, let's look at what's wrong with STEM?	那么，让我们看看 STEM 有什么问题?



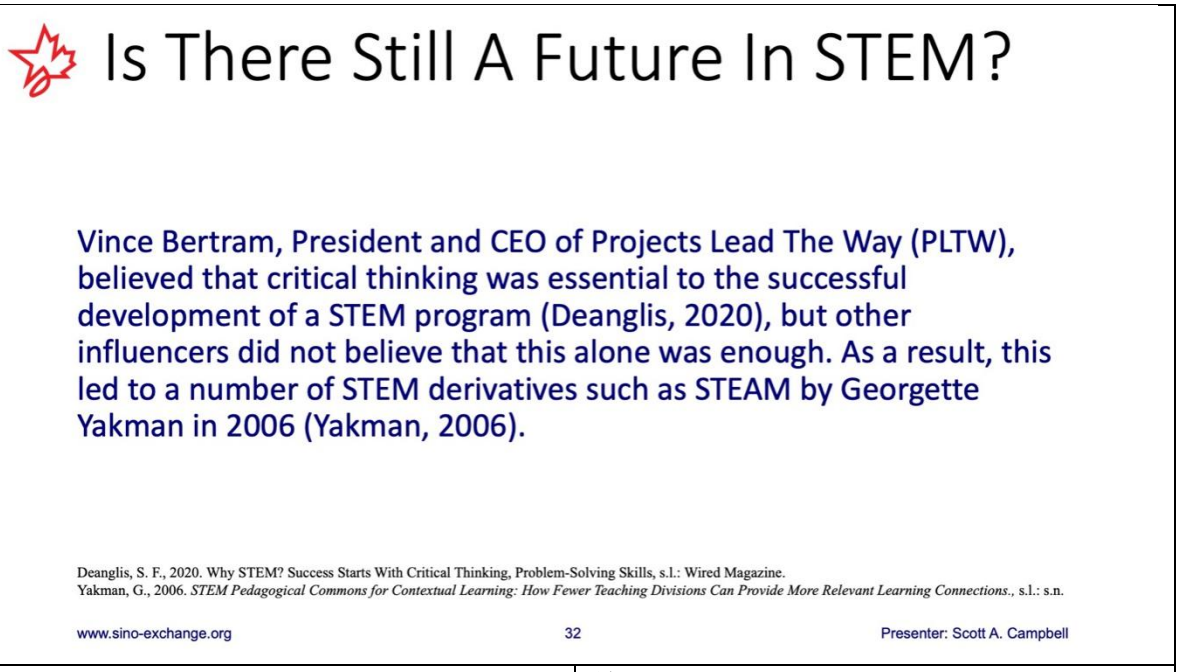
Well STEM means something very different to various stakeholder groups. • For instance, STEM means one thing to governments, particularly as they look at ways to develop a stronger economy, but also as a tool to protect their national sovereignty. • It also means something to industry professionals in strategic sectors that are critical to the economy. • Again, it means something very different to school administrators who look at it as a way of boosting student engagement and increasing school enrolment, and this is particularly true of private or international schools which are not publicly funded. • To K-12 educators who look at STEM as an educational framework. • And it also means something very different to corporations who look at it as a market opportunity with some of the best financial returns in the industry. Therefore, we come to one of the more recent problems with STEM education.	STEM 对不同的利益相关者群体来说意味着非常不同的东西。 • 例如，STEM 对政府来说意味着一件事，特别是当他们寻找发展更强大经济的方法时，同时也是保护国家主权的工具。 • 这对对对经济至关重要的战略部门的行业专业人士也有意义。 • 同样，对于学校管理人员来说，这意味着非常不同的事情，他们将其视为提高学生参与度和提高入学率的一种方式，而非公共资助的私立或国际学校尤其如此。 • 致将 STEM 视为教育框架的 K-12 教育工作者。 • 对于那些将其视为具有行业最佳财务回报的市场机会的公司来说，这也意味着非常不同的事情。 因此，我们遇到了 STEM 教育最近的一个问题…STEM 教育的垄断是为了经济利益，而不是教育利益，这种垄断正在创

The monopolization of STEM education for financial and not educational gains which is creating an unsuitable educational model… that if left uncheck could seriously impact the future of STEM education. Now you might think that I am going to say that “corporations are evil” or you might already feel that way after seeing your school budgets eroded away by expensive educational products. But that’s not the point I am trying to make. These corporations only responded to a need within education, a need that we ourselves have created. And this, in part was because teachers were asked to do something without being given the proper support or resources that they needed to implement such a grand vision. Therefore, the problems that we face today were created collectively by our society at large. But regardless of how we got here… we need to start looking at ways to solve these problems together.	建一种不合适的教育模式，如果不加以控制，可能会严重影响 STEM 教育的未来。 现在你可能会认为我要说的是“公司是邪恶的”，或者在看到昂贵的教育产品侵蚀了你的学校预算后，你可能已经有了这种感觉。但这不是我想要表达的观点。这些公司只是回应了教育内部的需求，这是我们自己创造的需求。这在一定程度上是因为教师们被要求在没有得到实施这样一个宏伟愿景所需的适当支持或资源的情况下做一些事情。因此，我们今天面临的问题是我们整个社会共同造成的。但不管我们是如何走到这一步的……我们都需要开始寻找共同解决这些问题的方法。

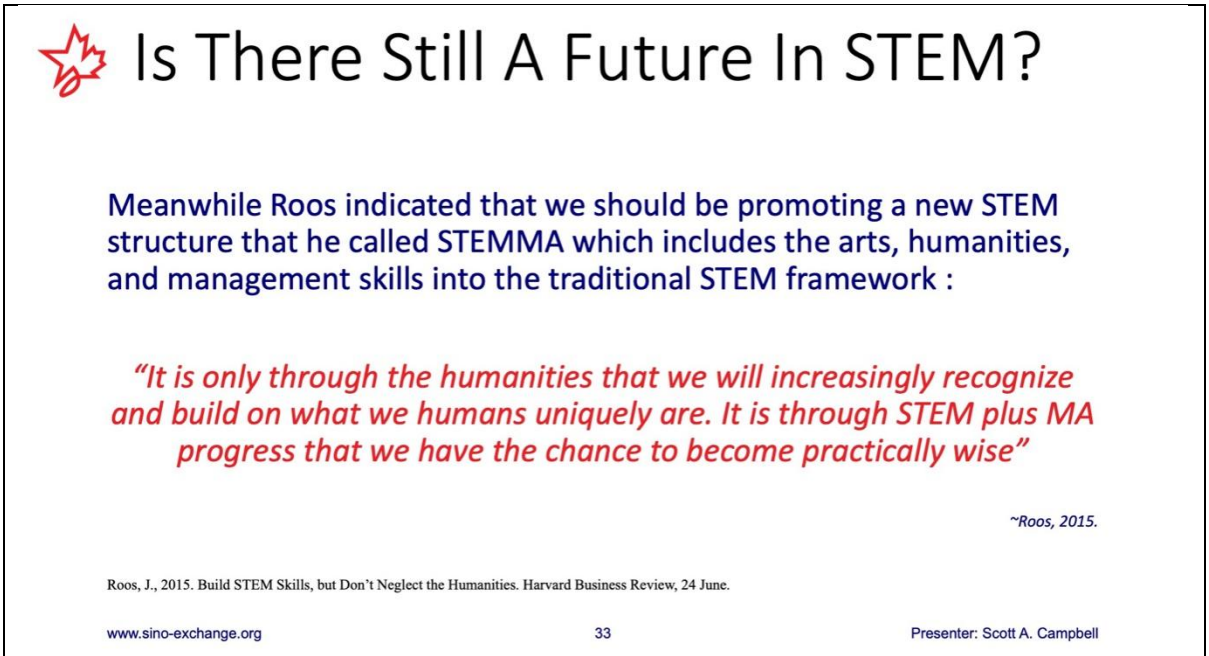


Now it's widely accepted that the acronym **STEM** stands for: "**science**, **technology**, **engineering** and **mathematics**." And I don't think anyone would argue with that! It seems that everybody knows what STEM is! But most people don't seem to understand what STEM is based on how much confusion there is surrounding STEM and all its derivatives. So let me delve into this idea.	现在，人们普遍认为缩写 STEM 代表"科学、技术、工程和数学" 我想没有人会对此争论！似乎每个人都知道什么是 STEM！但大多数人似乎并不理解什么是 STEM，这是基于围绕 STEM 及其所有衍生物的困惑。所以让我深入研究一下这个想法。
Now I think most people are aware of Blooms taxonomy, but if you don't – Blooms taxonomy is a classification of the different levels of thinking or cognition. This is where knowledge is placed at the bottom, and as we develop our understandings, we can start applying what we know and eventually synthesize and evaluate the results of our own thought process.	现在我想大多数人都知道布鲁姆斯分类法，但如果你不知道的话——布鲁姆斯分类是对不同思维或认知水平的分类。这就是知识被置于底层的地方，当我们发展理解时，我们可以开始应用我们所知道的，并最终综合和评估我们自己思考过程的结果。
And I think that this is important for us to stop and think about. **Everybody has knowledge of what STEM is, but very few people have a deeper understanding of the true nature of STEM or what it should be!** And we as educators we know that there is a **big difference between knowledge and understanding**.	我认为这对我们来说很重要，要停下来思考。每个人都知道什么是 STEM，但很少有人对 STEM 的真实本质或它应该是什么有更深入的了解！作为教育工作者，我们知道知识和理解之间有很大的区别。

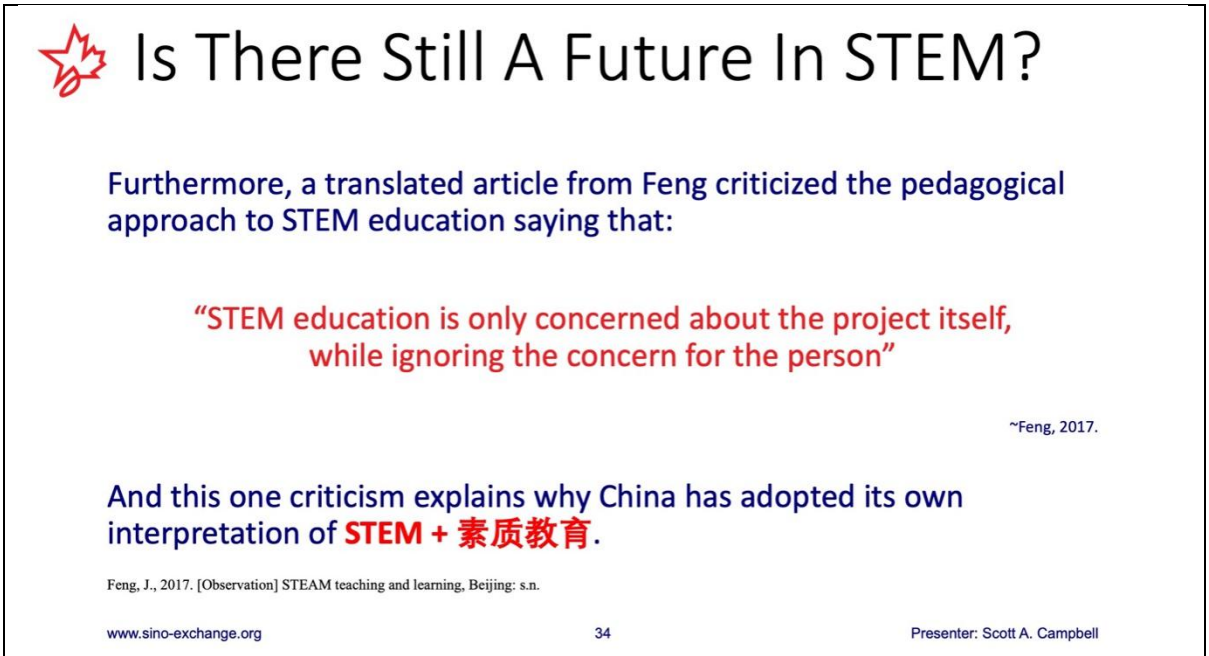
Therefore, we need to move beyond the rudimentary knowledge of what STEM is and challenge our own assumptions, but before we do that, let's look at some of the criticism that have been made of the STEM framework.	因此，我们需要超越 STEM 的基本知识，挑战我们自己的假设。但在我们这样做之前，让我们看看对 STEM 框架的一些批评。



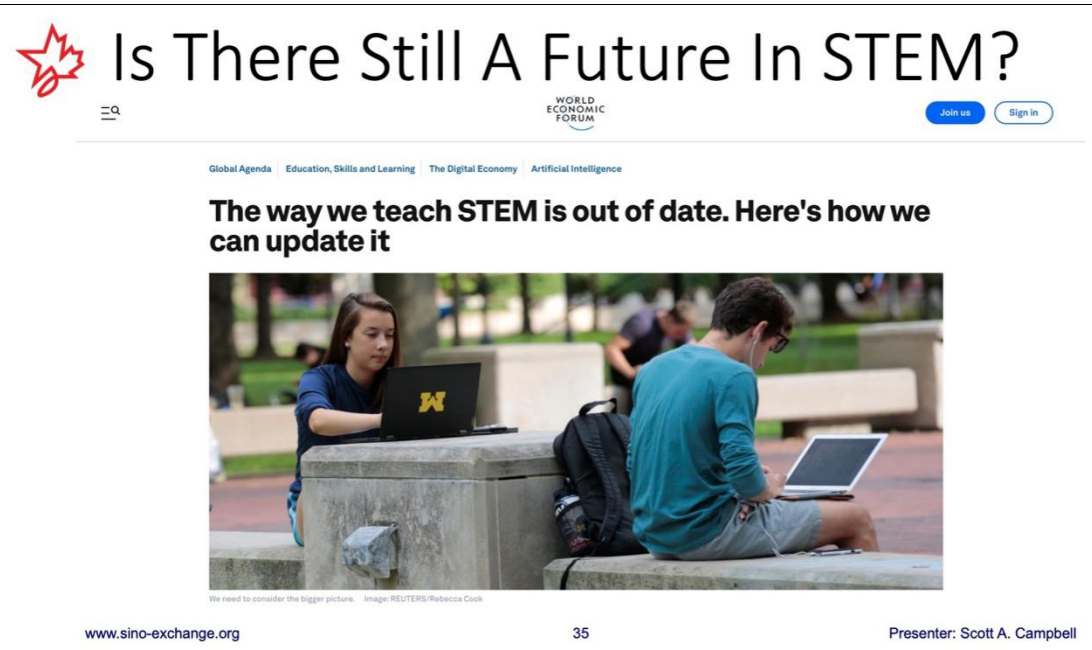
First, I would like to direct you to comments made by Vince Bertram who indicated that: ***"That critical thinking is panicle to the successful development of a STEM program".***	首先，我想向你介绍 Vince Bertram 的评论，他表示："这种批判性思维是 STEM 项目成功开发的关键"。
However, other educators didn't think that this was enough, and this led to Georgette Yakman introducing an educational derivative known STEAM, which I'm sure you are all well aware of!	然而，其他教育工作者认为这还不够，这导致 Georgette Yakman 推出了一种名为 STEAM 的教育衍生产品，我相信你们都很清楚!



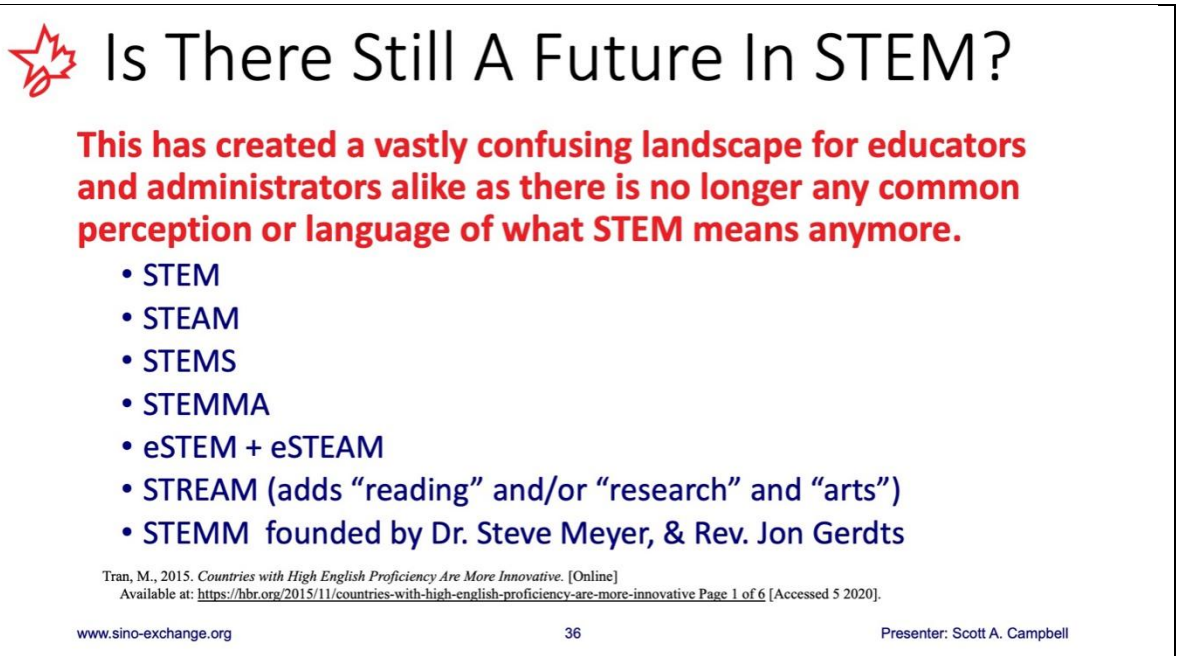
Meanwhile Roos believes that we should promote a new structure that also includes the arts and humanities stating that: *"It is through STEM plus MA progress that we have the chance to become practically wise."*	与此同时，鲁斯认为，我们应该推广一种新的结构，其中也包括艺术和人文学科，并表示："正是通过 STEM 加 MA 的进步，我们才有机会变得务实明智。"



Furthermore, Feng goes on to criticizes the superficial nature of STEM indicating that "STEM education is only concerned about the project itself, while ignoring the concern for the person", and this criticism explains why China has adopted its own interoperation which they refer to as STEM + [sù zhì jiào yù] which essentially means STEM plus quality moral education.	此外，冯还批评了 STEM 的肤浅本质，指出"STEM 教育只关心项目本身，而忽视了对个人的关心"，这一批评解释了为什么中国采用了自己的配合动作，他们称之为 STEM+[súzhìjiào yú]，本质上意味着 STEM 加上素质道德教育。

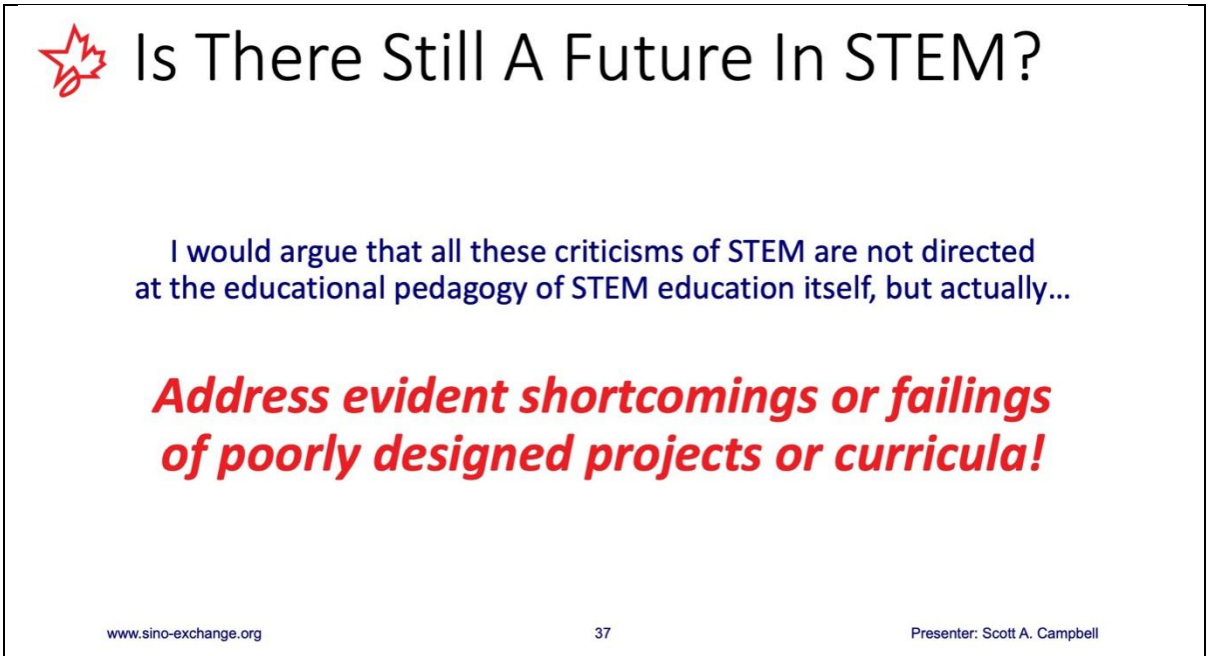


Even the World Economic Forum has called for reform in STEM education. Indicating that ***"we should also expand the scope of STEM education, to ensure that students learn to evaluate and respond to the social, economic, and political consequences of their work."*** Now all these examples illustrate some very critical views on STEM education and presents a grim outlook for the future of STEM. So much so, that these criticisms might lead you to think that there is no future in STEM education. But I don't believe that!	甚至世界经济论坛也呼吁对 STEM 教育进行改革。表示"我们还应该扩大 STEM 教育的范围，以确保学生学会评估和应对其工作的社会、经济和政治后果。以至于这些批评可能会让你认为 STEM 教育没有未来。 但我不相信!

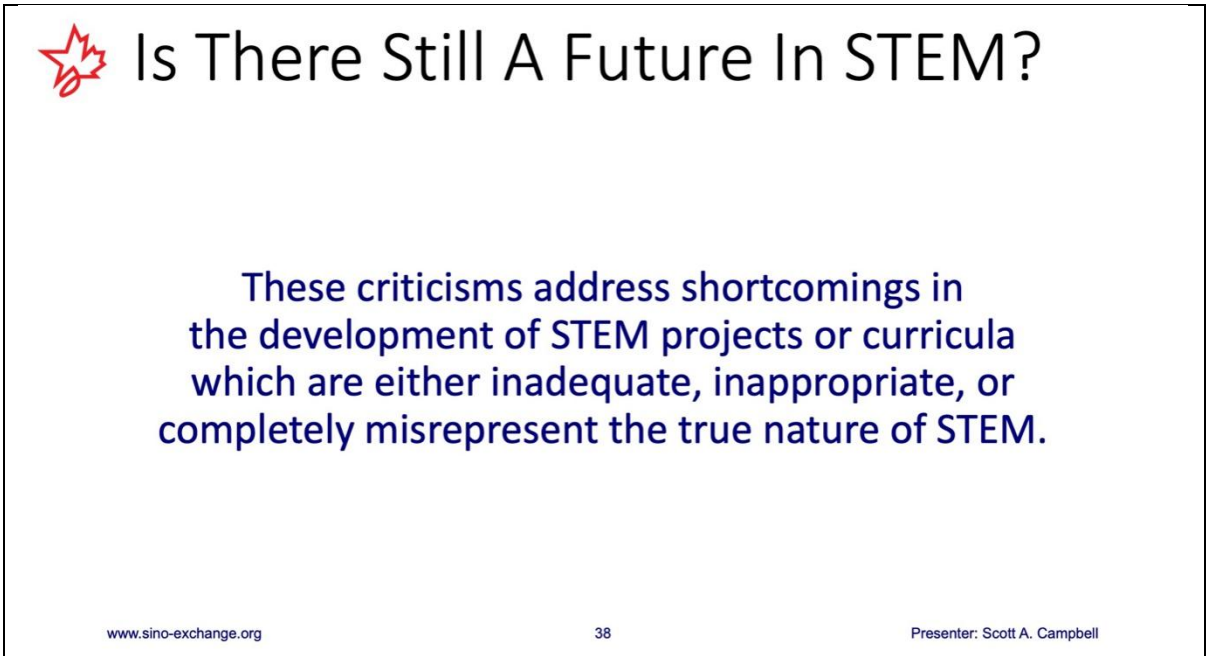


Now while these criticisms are valid. They didn't solve the problem. Instead, numerous STEM derivatives were created to solve a problem, **without understanding what caused the problem in the first place.** And this has created incredibly confusing landscape for educators and administrators alike…	现在，尽管这些批评是有效的。他们没有解决问题。相反，许多 STEM 衍生物是为了解决问题而创建的，而不了解最初是什么导致了问题。 这给教育工作者和管理者带来了令人难以置信的困惑…
But the worst part is, because of all these STEM derivatives there is no longer any language or common perception of what STEM is anymore! And that has made the problem even worse.	但最糟糕的是，由于所有这些 STEM 衍生物，不再有任何语言或对 STEM 的共同认知！这使得问题更加严重。
So, let's look at some of the popular acronyms. • We have STEM. • We also have STEAM which adds creativity through the arts, and I think everybody already knows these two acronyms. • We have STEMS which recognizes the importance Social Sciences by adding the S at the end of the acronym. • STEMMA which adds Managerial Arts and was first proposed by Harvard University.	所以，让我们来看看一些流行的缩写词。 • 我们有 STEM。 • 我们还有 STEAM，它通过艺术增加创造力，我想每个人都知道这两个缩写词。 • 我们有 STEMS，它通过在首字母缩写的末尾添加 S 来认识社会科学的重要性。 • STEMMA 增加了管理艺术，由哈佛大学首次提出。 • 接下来，我们有 eSTEAM，它认识到发展英语读写能力的重要性，这是一个重要的概念，Tran 进行

• Next, we have eSTEAM which recognizes the importance of developing English Literacy skills, and this is important concept that is further substantiated by research that was conducted by Tran who indicates that "***countries with high English proficiency are more innovative as they have access to a wider breadth of current research material from the global community" (Tran, 2015).*** Therefore, this idea of including an ESL focus in STEM education is important concept that will help students in none-English speaking courtiers develop the skills they need to access a wider range of research materials. • This leads us to another derivate know as STREAM with adds reading and research to the STEM framework. • And finally, we have STEMM with a double M which was created by Dr. Steve Meyer and Revant Jon Gerdts who add the values of Christin Missionary to the mandate of STEM education. This also ties in with the idea that the World Economic Form had, but from a slightly religious stand-point, and also corresponds to the ideas that the Chinese had by combining with STEM with [sù zhì jiào yù], or quality moral education.	的研究进一步证实了这一点，Tran 指出"英语水平高的国家更具创新性，因为他们可以从国际社会获得更广泛的当前研究材料"（Tran，2015）。 因此，在 STEM 教育中纳入 ESL 重点的想法是一个重要的概念，它将帮助非英语朝臣的学生发展获得更广泛研究材料所需的技能。 • 这使我们找到了另一个被称为 STREAM 的衍生物，它为 STEM 框架增加了阅读和研究。 • 最后，我们有一个带有双 M 的 STEMM，由 Steve Meyer 博士和 Revant Jon Gerdts 创建，他们将 Christin Missionary 的价值观添加到 STEM 教育的任务中。这也与世界经济形态的理念相联系，但从一个稍微有点宗教色彩的角度来看，也与中国人将 STEM 与[sùzhìjiào yú]或素质道德教育相结合的理念相一致。

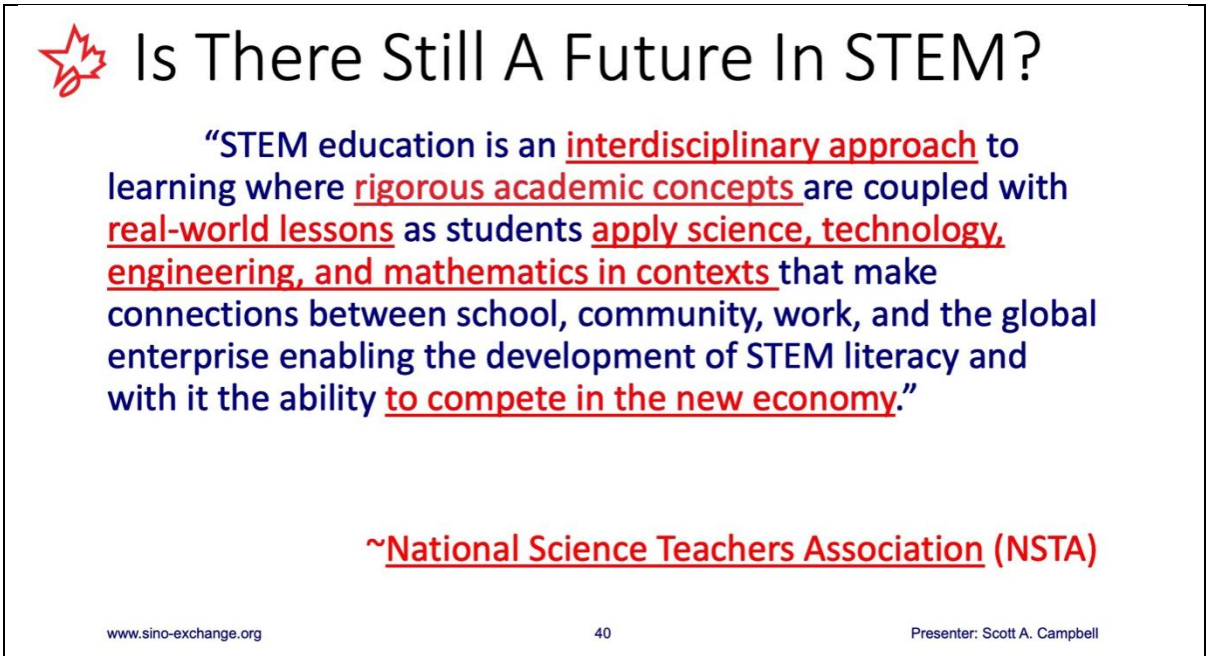


Now I would argue that these criticisms of STEM are not actually directed at the educational pedagogy of STEM itself but address evident shortcomings or failings of poorly designed projects or curricula! So, let me summarize everything here for a moment.	现在我认为，这些对 STEM 的批评实际上并不是针对 STEM 本身的教育教学法，而是针对设计糟糕的项目或课程的明显缺陷或失败! 所以，让我总结一下这里的所有内容。
All these comments indicated a lack of creativity. A lack of meaningful connections with the human or social aspects of what we do or why we do it, and that STEM places to much emphasis on the act of doing instead of on reaching the desired learning outcomes. However, if we look at careers in STEM, which we will do in a moment, you will see that these shortcomings are critical aspects of what these professionals do on a daily basis!	所有这些评论都表明缺乏创造性。与我们所做的事情或为什么要做的人类或社会方面缺乏有意义的联系， STEM 非常重视行动，而不是达到期望的学习结果。然而，如果我们看看 STEM 的职业生涯，你会发现这些缺点是这些专业人士日常工作的关键方面!
And for that reason, I believe that all these criticisms of STEM education are invalid.	因此，我认为所有这些对 STEM 教育的批评都是无效的。



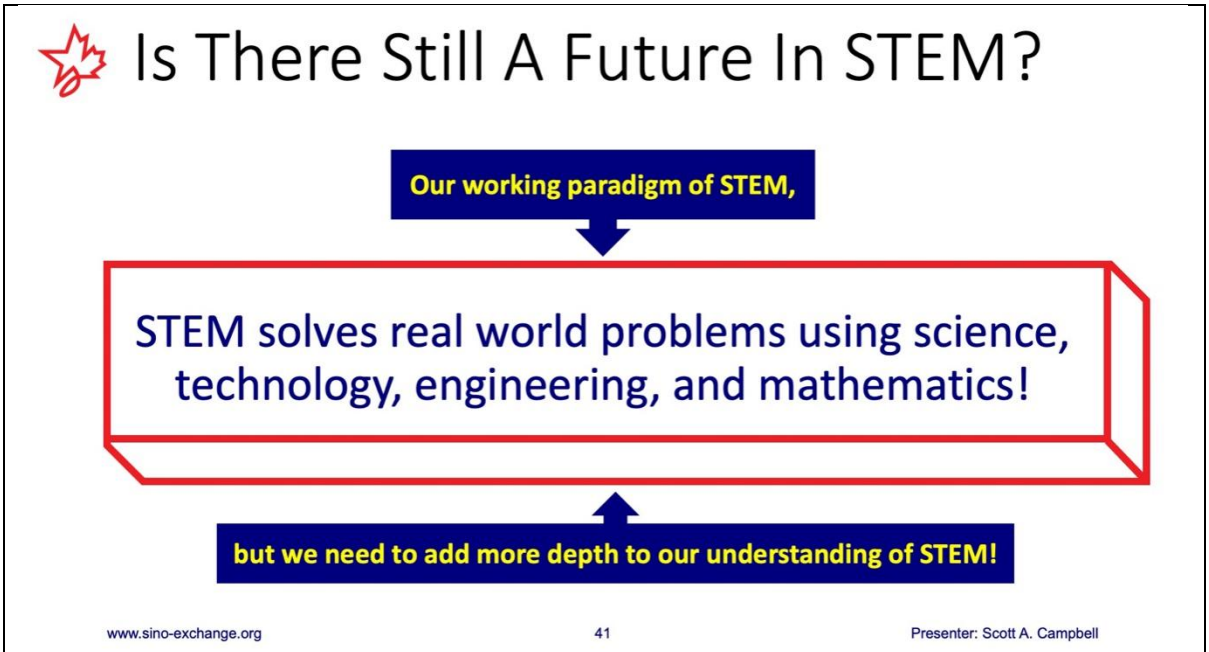
Because all these criticisms address shortcomings in the development STEM projects or curricula which are either: inadequate, inappropriate, or completely misrepresent the true nature of STEM education. That is why I have chosen to continue use the word STEM instead of STEAM or any other derivative that might be trending in the current marketplace. Because at the end of the day, the development of these derivatives has only served to further complicate matters! While also adding uncertainty and confusion to our understanding of STEM education. Moreover, this has distracted us from solving the problem at hand, which is understanding the true nature of STEM education, and ensuring that what we are doing in the classroom, such as designing projects and curricula, do in fact support to the desired learning outcomes.	因为所有这些批评都涉及 STEM 项目或课程开发中的缺陷，这些缺陷要么是：不充分、不恰当，要么完全歪曲了 STEM 教育的真实性质。这就是为什么我选择继续使用 STEM 这个词，而不是 STEAM 或任何其他可能在当前市场上流行的衍生产品。因为归根结底，这些衍生品的开发只会使事情进一步复杂化！同时也给我们对 STEM 教育的理解增加了不确定性和困惑。此外，这分散了我们对解决手头问题的注意力，即理解 STEM 教育的本质，并确保我们在课堂上所做的事情，如设计项目和课程，实际上是对期望的学习成果的支持。

So, let's start thinking about what STEM is and really develop upon our conceptual paradigm of STEM. Because with all the confusion surrounding STEM, we may not actually have a deep enough understanding to be able to properly define the true nature of STEM education. But more importantly, we need a clear and concise definition STEM that we can use to evaluate and assess our own teaching practices.	因此，让我们开始思考什么是 STEM，并真正发展我们的 STEM 概念范式。因为围绕 STEM 的所有困惑，我们实际上可能还没有足够深入的理解，无法正确定义 STEM 教育的本质。但更重要的是，我们需要一个清晰简洁的 STEM 定义，我们可以用来评估和评估我们自己的教学实践。

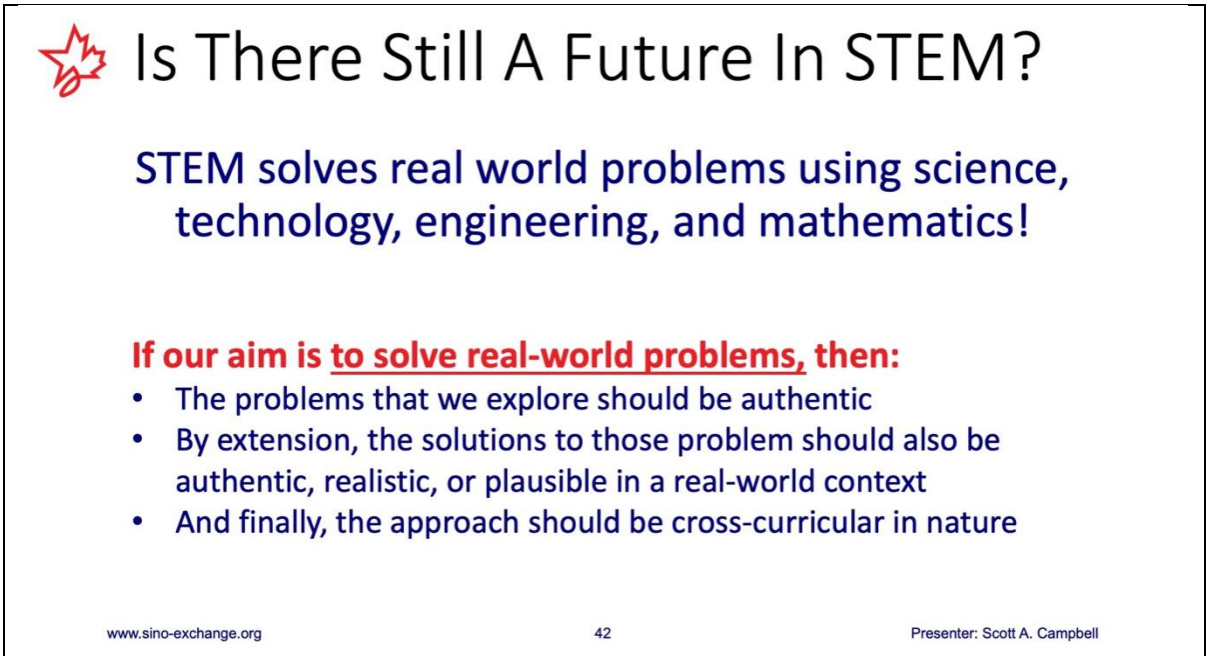


I really like this definition of STEM because it upholds the original ideals for STEM education that were introduced back in 2001. So, lets read through this definition together. "STEM education is an interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons as students apply science, technology, engineering, and mathematics in contexts that make connections between school, community, work, and the global enterprise enabling the development of STEM literacy and with it the ability to compete in the new economy." WOW! This definition is very verbose, and it's hard to unpack because it's so dense. So, I am going to highlight a few key words here: • interdisciplinary approach • rigorous academic concepts • real-world lessons • apply science, technology, engineering, and mathematics in contexts • to compete in the new economy	我真的很喜欢 STEM 的定义，因为它支持 2001 年引入的 STEM 教育的最初理想。所以，让我们一起通读这个定义。 "STEM 教育是一种跨学科的学习方法，严格的学术概念与现实世界的课程相结合，学生将科学、技术、工程和数学应用于学校、社区、工作和全球企业之间的联系，从而促进 STEM 素养的发展，并有能力在新经济中竞争。" 哇! 这个定义非常冗长，而且很难解压缩，因为它太密集了。因此，我将在这里强调几个关键词： • 跨学科方法 • 严谨的学术理念 • 真实世界的经验教训 • 在环境中应用科学、技术、工程和数学 • 在新经济中竞争

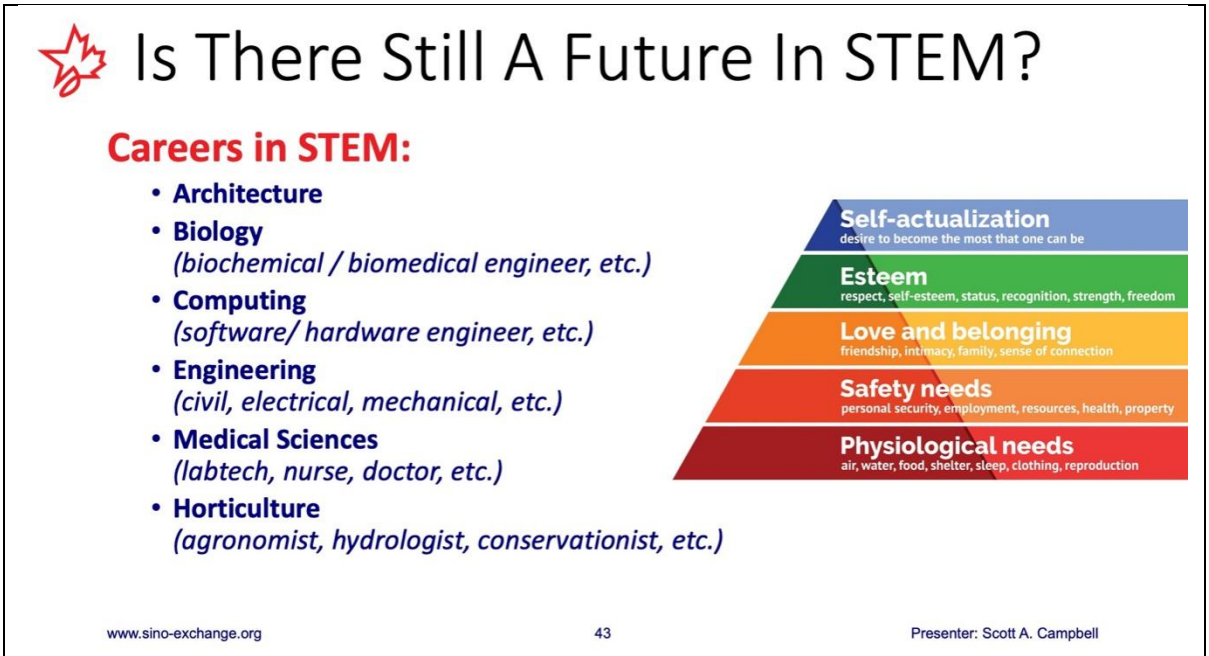
• Now as I have already mentioned, STEM is linked to economic growth and national sovereignty, and we can't forget about this connection because this is really the main driving force at the government level for STEM. However, this definition, great as its… is hard to take in all at once. Therefore, let's try simplifying this definition before moving on.	• 正如我已经提到的，STEM 与经济增长和国家主权有关，我们不能忘记这种联系，因为这确实是政府层面推动 STEM 的主要力量。 然而，这个伟大的定义……很难一下子被接受。因此，在继续之前，让我们试着简化这个定义。



STEM solves real world problems using science, technology, engineering, and mathematics!	STEM 利用科学、技术、工程和数学解决现实世界中的问题!
This is the simplest definition that I can make to define STEM, and I have never had anyone objection to this definition. However, as I mentioned earlier, paradigms establish boundaries, and these boundaries shape our perceptions.	这是我能给 STEM 下的最简单的定义，从未有人反对过这个定义。然而，正如我前面提到的，范式建立了界限，而这些界限塑造了我们的观念。
Now conceptual paradigms are not inherently bad, unless they limit our ability to see the obvious, and that is what we need to do right now.	现在，概念范式本质上并不坏，除非它们限制了我们看到显而易见的东西的能力，而这正是我们现在需要做的。
Currently our paradigm, which I have represented by a red box is incredibly small, and this is going to limit our understanding of STEM. Therefore, we need to add a bit more depth.	目前，我用红框表示的我们的范式非常小，这将限制我们对 STEM 的理解。因此，我们需要增加一点深度。
So, lets expand upon our understanding of STEM education.	因此，让我们进一步了解 STEM 教育。



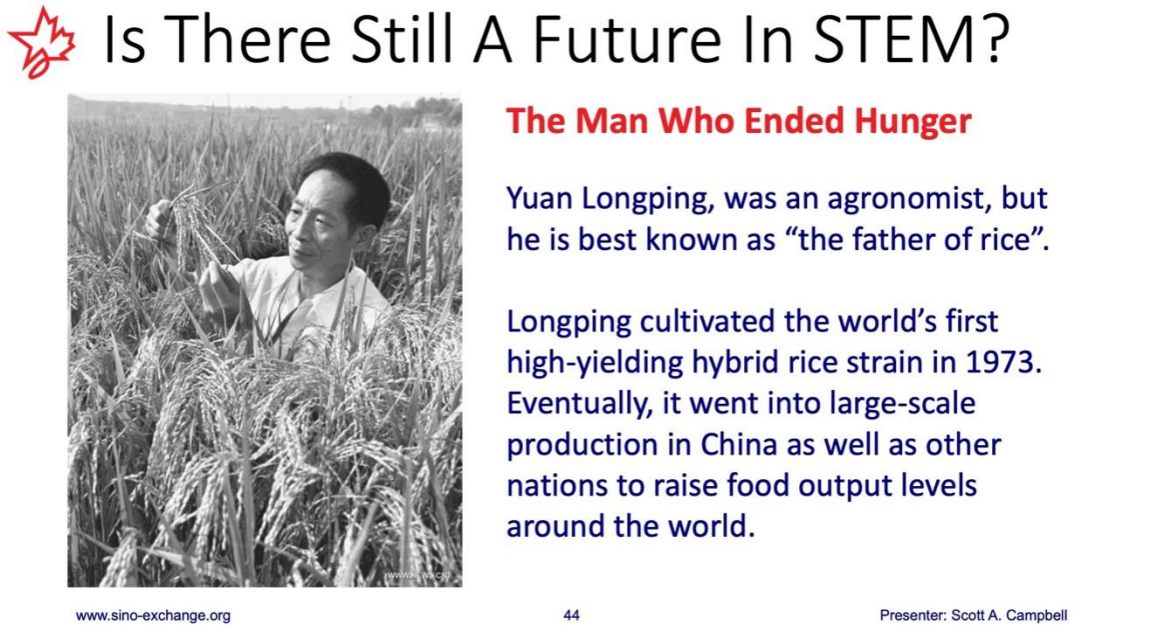
If our aim is to solve real-world problems, then: 1. Then the problems that we explore should be authentic. 2. By extension, the solutions to those problem should also be authentic. 3. And finally, the approach should also be cross-curricular.	如果我们的目标是解决现实世界中的问题，那么： • 那么我们探索的问题应该是真实的。 • 从广义上讲，这些问题的解决方案也应该是真实的。 • 最后，这种方法也应该是跨课程的。



So, let's look at some careers in STEM. We have the fields of: • Architecture • Biology • Computing • Engineering • The medical sciences • And Horticulture just to name a few. I should also indicate that although there are thousands of careers in STEM, I am only able to showcase a select few. Now at first glance these fields all look completely different, and you might say that there's commonality between any of them, and it never even occurs to most people to even look for a common link between unrelated careers… But this link is critical for us to develop a deeper understanding of what STEM is. Now if the relationship is not evident to you, don't worry. It's not something that would be naturally intuitive so let me start by showing you Maslow's "hierarchy of needs". You might not see the connection yet but let me start with the architect. Simply put,	所以，让我们来看看 STEM 的一些职业。 我们拥有以下领域： • 建筑设计 • 生物学 • 计算机 • 工程学 • 医学 • 还有园艺，仅举几个例子。 我还应该指出，尽管 STEM 有成千上万的职业，但我只能展示少数几个。 现在，乍一看，这些领域看起来都完全不同，你可能会说，它们之间都有共同点，大多数人甚至从未想过在不相关的职业之间寻找共同点……但这种联系对于我们更深入地理解什么是 STEM 至关重要。 现在，如果这种关系对你来说并不明显，不要担心。这不是一件自然直观的事情，所以让我首先向你展示马斯洛的"需求层次"。 你可能还看不到这种联系，但让我从建筑师开始。简单地说，建筑师设计建

an architect designs buildings, but if we delve a bit deeper, we can see that they create a wide array of structures. These structures include homes, schools, and hospitals, but no matter how simple or extravagant these structures are they provide us with “SHELTER” which is one of our most fundamental human “NEEDS”, and these needs are not isolated. Everyone in society needs shelter, access to education and health care, and places to connect. Therefore, architects serve “SOCIETAL NEEDS”.	筑，但如果我们深入研究，我们可以看到他们创造了一系列广泛的结构。这些结构包括住宅、学校和医院，但无论这些结构多么简单或奢华，它们都为我们提供了“避难所”，这是我们人类最基本的“需求”之一，这些需求并不是孤立的。社会上的每个人都需要住所、获得教育和医疗保健的机会，以及建立联系的地方。因此，建筑师服务于“社会需求”。
Next, the various felids in biology, and this one I think is very germane to our society right now. During the COVID-19 outbreak researchers and biochemists alike were sequencing viral mutations, creating vaccinates, and therapeutic drugs. Meanwhile Biomedical Engineers were creating ventilators and other protective equipment to end the pandemic. Therefore, individuals in these fields were solving real-world problems that address the “NEEDS of SOCIETY”.	接下来，生物学中的各种猫科动物，我认为这只与我们现在的社会非常密切。在新冠肺炎爆发期间，研究人员和生物化学家都在对病毒突变进行测序，研制疫苗和治疗药物。 与此同时，生物医学工程师正在研制呼吸机和其他防护设备，以结束疫情。因此，这些领域的个人正在解决现实世界中的问题，以满足“社会需求”。
And what about in the field of computing? While some programs do make things like games, many are engaged in the development and maintenance of programs that keep our societies running. Programmers create the traffic control systems that change the lights at the intersection, the power management systems that control the National Grid, and even the software that controls that life support systems in the hospital. Moreover, hardware engineers develop new and innovative solutions that make all these things possible. So again, these professionals are solving real-world problems that address the “NEEDS of SOCIETY”.	那么在计算领域呢？虽然有些程序确实制作了类似游戏的东西，但许多程序都参与了维持我们社会运转的程序的开发和维护。程序员创建了改变十字路口灯光的交通控制系统，控制国家电网的电力管理系统，甚至控制医院生命支持系统的软件。此外，硬件工程师开发新的创新解决方案，使所有这些成为可能。因此，这些专业人士正在解决现实世界中的问题，以满足“社会需求”。
I think at this point Engineering and the Medical Sciences would be self-explanatory	我认为在这一点上，工程学和医学科学将是不言自明的，因为这些专业有助于

as these professions help to create and maintain a healthy and functional society, s I am going to jump to the last one which is Horticulture.	创建和维持一个健康和功能良好的社会，我将跳到最后一个，也就是园艺。



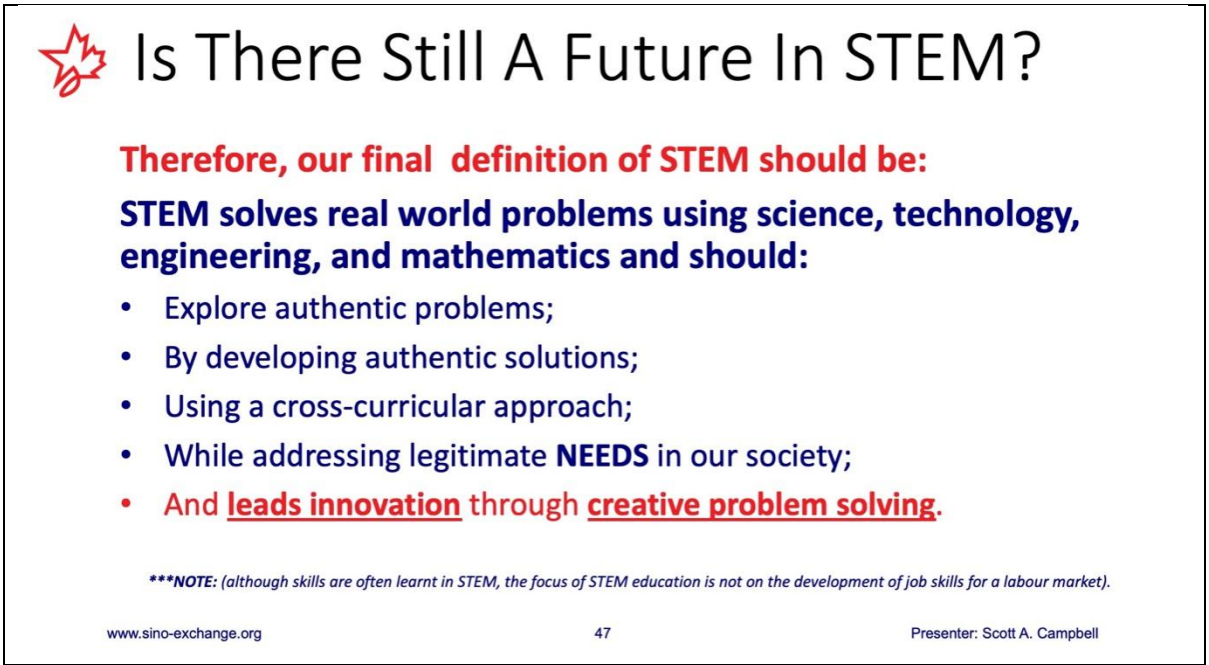
In this example I would like to introduce you to Yuan Longping who is well known as the "**Man That Ended Hunger**". His research into hybrid rice strains saved millions of lives during the great famine and is now feeding nearly one-fifth of the world's population with less than 9% percent of the world's total land, and this is a prime example of what experts in various STEM fields do for a living! They solve real-world problems that address a **legitimate NEED** in our society, and that I think is another important qualifier that we need to add to our definition of STEM education.	在这个例子中，我想向你介绍袁隆平，他被称为"结束饥饿的人"。他对杂交水稻品种的研究在大饥荒期间挽救了数百万人的生命，现在用不到世界总土地 9%的土地养活了世界近五分之一的人口，这是各个 STEM 领域专家谋生的最好例子！它们解决了现实世界中的问题，解决了我们社会的合法需求，我认为这是我们需要添加到 STEM 教育定义中的另一个重要限定词。
Careers in STEM address real NEEDS in our societies… and not individual wants or desires.	STEM 职业解决了我们社会的真正需求…而不是个人的愿望或欲望。

So, I'd like you to look at these photographs for a moment and decide if both of these would represent a career in STEM? Think about it for a moment! Afterall both individuals are working the in the field of horticulture. What evidence can you provide to support your argument?	所以，我想让你看一下这些照片，看看这两张照片是否都代表 STEM 的职业生涯？ 想一想！毕竟，两个人都在园艺领域工作。你能提供什么证据来支持你的论点？
Now I am assuming everyone said that the farmer did not represent a career in STEM, but when I put these photos side by side doesn't seem so clear anymore! So why does one of these a career represent a career in STEM while the other doesn't, and it is these kinds of murky situations really impact our understanding of STEM education. Especially when we don't have a conceptual paradigm that is deep enough to evaluate the true nature of STEM education!	现在，我假设每个人都说这位农民并不代表 STEM 的职业生涯，但当我把这些照片放在一起时，似乎不再那么清晰了！ 那么，为什么其中一个职业代表 STEM 职业，而另一个则不然，正是这些模糊的情况真正影响了我们对 STEM 教育的理解。尤其是当我们没有一个足够深入的概念范式来评估 STEM 教育的真实本质时！
Now the farmer on the right is helping to serve a real need in our society. They use a vast array of agricultural technologies to do their jobs. They apply different chemical or organic methods to improve crop yields, and they design irrigation systems to tend to their crops. So, wouldn't this be a career in STEM? Afterall, it meets so many of our criteria that we have come up with. So, let's	现在，右边的农民正在帮助满足我们社会的真正需求。他们使用大量的农业技术来完成他们的工作。他们采用不同的化学或有机方法来提高作物产量，并设计灌溉系统来照顾他们的作物。那么，这难道不是 STEM 的职业吗？毕竟，它符合我们提出的许多标准。所以，让我们再来看看这个。袁隆平是引领变革的创新者。

look at this again. Yuan Longping was an innovator who led change. He didn't grow all the rice that ended the famine, instead he created a new strand of rice which others could grow. The farmer on the other hand represents either skilled, or unskilled labor. They are not leading change or innovation, and this is a key distinction that we need to make. ***STEM is about leading innovation, and not about the development of general labor market.***	 他没有种植所有结束饥荒的水稻，而是创造了一种其他人可以种植的新水稻。另一方面，农民既代表熟练劳动力，也代表非熟练劳动力。他们并没有引领变革或创新，这是我们需要做出的一个关键区分。 STEM 是关于引领创新，而不是关于一般劳动力市场的发展。

So, what about any of these professional careers?	那么，这些职业生涯中的任何一个呢?
Many people generally associate STEM with hands on learning and skill development; Therefore high-skilled or professional looking jobs are offend considered to be a career in STEM, and this often influences our choices as educators when we try planning our curriculum and making classroom activities.	许多人通常将 STEM 与动手学习和技能发展联系在一起；因此，高技能或看起来专业的工作被认为是 STEM 的职业，这通常会影响我们在规划课程和进行课堂活动时作为教育工作者的选择。
Let's take Chief for instance. Is this STEM and what evidence do we have to support that argument? Well, we all need to eat, but as we saw with the example of the farmer… a chef is catering to individual wants or desirers. NOT a legitimate NEED that addresses a societal issue, and for this reason alone, being a chief is not a career in STEM.	让我们以酋长为例。 这是 STEM 吗？我们有什么证据支持这一论点？嗯，我们都需要吃饭，但正如我们在农民的例子中看到的那样…厨师是在满足个人的需求或渴望。不是解决社会问题的合法需求，仅凭这个原因，担任首席执行官不是 STEM 的职业。
Next the salesclerk, and this could be selling insurance or any number of luxury items such as designer clothes to sports cars… But again, these professionals again are catering to individual desires and not societal needs.	接下来是店员，这可能是向跑车销售保险或任何数量的奢侈品，如名牌服装…但是，这些专业人士再次迎合个人欲望，而不是社会需求。
But what about the contractor?	但承包商呢?

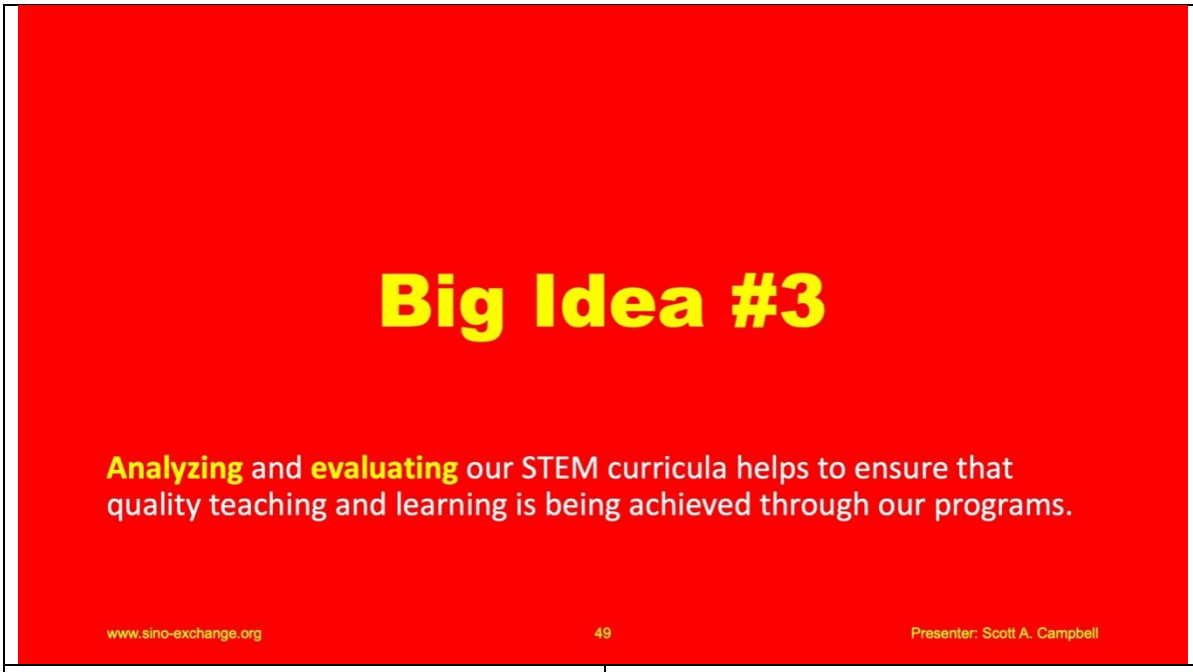
They are dealing with structural engineering, electrical systems, plumbing, and so much more. So, if Architecture and Civil Engineering are considered careers in STEM, should being a contractor be considered as career in STEM well? While the contractor has a working knowledge of engineering, they are the skilled workforce that executes the vision of the architects or the engineers. They are not the ones driving innovation. So again, we see the separation between innovation and skilled labor which needs to factor into our understand of the true nature of STEM.	他们正在处理结构工程、电气系统、管道等等。那么，如果建筑和土木工程被视为 STEM 职业，那么作为承包商是否也应该被视为是 STEM 职业？ 虽然承包商具有工程方面的工作知识，但他们是执行建筑师或工程师愿景的熟练劳动力。他们不是推动创新的人。因此，我们再次看到创新和熟练劳动力之间的分离，这需要纳入我们对 STEM 真正本质的理解。



At this point we should have a very clear definition of STEM education which is much easy for everyone to understand, and we have enough depth to critically analyze and evaluate our educational practices. So, let's quickly review what we have covered so far. **STEM solves real world problems using science, technology, engineering, and mathematics and should:** • **Explore authentic problems.** • **By developing authentic solutions.** • **Using a cross-curricular approach.** • **While address legitimate NEEDS in society** • **And should lead innovation through creative problem solving.** But I should also emphasize that although numerous hands-on skills are learnt in STEM, the focus of STEM education is not about developing skills for a general labor market but should be about leading innovation.	在这一点上，我们应该对 STEM 教育有一个非常清晰的定义，每个人都很容易理解。我们有足够的深度来批判性地分析和评估我们的教育实践。所以，让我们快速回顾一下到目前为止我们所涵盖的内容。 STEM 利用科学、技术、工程和数学解决现实世界中的问题，并且应该： • 探索真实的问题。 • 通过开发真实的解决方案。 • 采用跨课程的方法。 • 在满足社会合法需求的同时 • 并应通过创造性解决问题来引领创新。 但我也应该强调，尽管 STEM 学习了许多实践技能，但 STEM 教育的重点不是为一般劳动力市场培养技能，而是引导创新。

So, if we go back at all the criticisms that have been made of STEM, we can see that these arguments are invalided based on our current framework. Let's quickly review each of them one at a time: • STEM lacks creativity! • STEM omits the humanities! • STEM lacks management skills! • STEM only focuses on the project itself! • STEM dose not respond to social or economic consequence! As we have seen STEM is all about creative problem solving and often requires us to look at problems from a different perspective; therefore, STEM dose involve creativity and critical thinking. STEM is in fact centered around the humanities, and we can see this by the focus of solving real-world problems that are centered around societal needs…. and our curriculum design in STEM should also mimic this reality as well. The fact that STEM lacks management skill is also a misnomer as STEM is all about leading innovation… And this requires students to learn about project	因此，如果我们回顾一下对 STEM 的所有批评，我们可以看到，基于我们目前的框架，这些论点是无效的。让我们一次一个地快速回顾它们中的每一个： • STEM 缺乏创造力！ • STEM 忽略了人文学科！ • STEM 缺乏管理技能！ • STEM 只关注项目本身！ • STEM 不会对社会或经济后果作出反应！ 正如我们所看到的，STEM 是关于创造性解决问题的，通常要求我们从不同的角度看待问题；因此，STEM 涉及创造力和批判性思维。 事实上，STEM 是以人文学科为中心的，我们可以从解决以社会需求为中心的现实世界问题中看到这一点…。我们的 STEM 课程设计也应该模仿这一现实。 STEM 缺乏管理技能这一事实也是一个用词不当的说法，因为 STEM 完全是为了领导创新……这需要学生学习项目管理、协作，同时培养沟通技能。因此，我们应

management, collaboration, while also developing communication skills as well. Therefore, we should be able to see that STEM should cover these skill sets if it is being done properly.	该能够看到，如果 STEM 做得好，它应该涵盖这些技能。
Next, the fact that there is a growing number of people saying that STEM only focuses on the project is a concerning trend, and part of this is because of the number of DIY kits that are being sold under the guise of STEM education. Now there is nothing wrong with DIY kits, or the companies that sell them, but these DIY kits often do not uphold the ideology of STEM education. However, the use of these kits is growing exponentially, and this being driven by the amount of confusion surrounding STEM education, and a lack of support being given to educators who have been thrown into a program without any training or support.	接下来，越来越多的人说 STEM 只关注这个项目，这是一个令人担忧的趋势，部分原因是打着 STEM 教育的幌子出售的 DIY 工具包的数量。现在，DIY 工具包或销售它们的公司都没有错，但这些 DIY 工具包往往不支持 STEM 教育的意识形态。然而，这些工具包的使用呈指数级增长……这是由于围绕 STEM 教育的大量混乱，以及对那些在没有任何培训或支持的情况下被投入项目的教育工作者缺乏支持。
And finally, that STEM does not consider the social impacts of innovation. Again, this statement is completely inaccurate.	最后，STEM 没有考虑创新的社会影响。同样，这种说法是完全不准确的。
Look at the development of the hybrid rice strand by Yuan Longping, or the study of renewable energy!	看看袁隆平对杂交水稻的开发，或者可再生能源的研究！
Look at the development of all the technologies that we use every day which improves our lives!	看看我们每天使用的所有技术的发展，这些技术改善了我们的生活！
And then think about how all these innovations have impacted the social and economic wellbeing of our society!	然后想想所有这些创新是如何影响我们社会的社会和经济福祉的！
Therefore, all these criticisms are invalid, and that's why I have decided to continue use the STEM acronym. Because at the end of the day there is nothing wrong with STEM education if it is done properly!	因此，所有这些批评都是无效的，这就是为什么我决定继续使用 STEM 首字母缩写。因为归根结底，如果 STEM 教育做得好，它没有错！



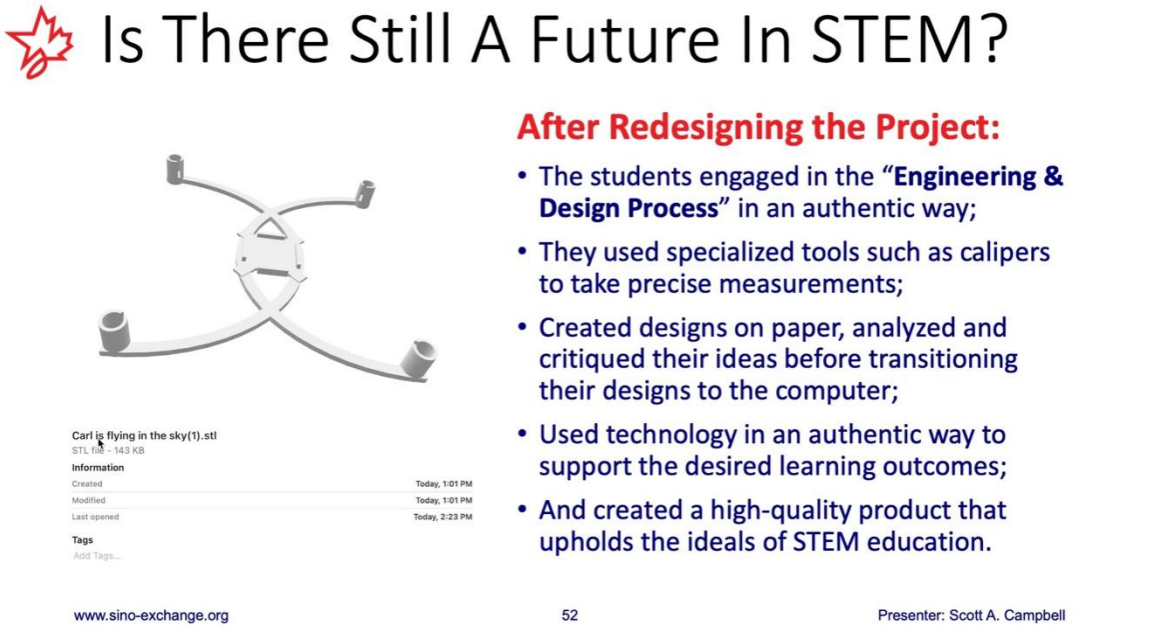
And that brings us to BIG IDEA #3. At this point I would like to provide you with some classroom examples to apply our current understanding of STEM education. As we saw with the original definition for STEM education, the goal is to create real-world lessons that apply Science, Technology, Engineering, and Mathematics in an authentic context, and this is an important because it helps show our students the reason why they're learning these concepts in the first place which provides clarity as the students can then to understand the value of what they are learning, visualize their future career paths, and begin to imaging the type life-long learning that's going to be associated with that journey. However, in-order for us to make that kind of impact we need to make sure that the learning opportunities that we offer our students are meaningful, authentic, and academically simulating. Therefore, we need to ensure that our projects uphold rigorous academic standards that will help prepare our students for the new global economy! So building on this idea we will review several STEM projects, evaluate them based	这就引出了第三个大创意。 在这一点上，我想为您提供一些课堂示例，以应用我们目前对 STEM 教育的理解。正如我们在 STEM 教育的原始定义中所看到的，目标是创建真实世界的课程，在真实的背景下应用科学、技术、工程和数学，这一点很重要，因为它有助于向我们的学生展示他们首先学习这些概念的原因，这使学生能够清楚地理解他们所学的东西的价值，想象他们未来的职业道路，并开始想象与这一旅程相关的终身学习类型。然而，为了让我们产生这样的影响我们需要确保我们为学生提供的学习机会是有意义的、真实的和学术模拟的。 因此，我们需要确保我们的项目坚持严格的学术标准，这将有助于我们的学生为新的全球经济做好准备。 因此，在这一理念的基础上，我们将审查几个 STEM 项目，根据年级水平的期望

on grade level expectations, and then we'll look at ways to ensure that we are either achieving or exceeding the desired learning outcomes.	对其进行评估，然后我们将研究如何确保我们达到或超过预期的学习成果。

Here are several projects from a grade 11 program that I worked with a few years ago. Now if our goal is to create a rigorous academic program that will foster innovation in key economic sectors, and this is what we are doing in a grade 11 program, then we have a serious problem! And the school thought so as well. Therefore, I started going through these projects and I did see some potential in some of these project ideas. So, let's focus on this drone project in more detail.	下面是我几年前参与的一个 11 年级项目的几个项目。 现在，如果我们的目标是创建一个严格的学术项目，促进关键经济部门的创新，而这正是我们在 11 年级项目中所做的事情，那么我们就有大问题了！学校也这么认为。因此，我开始研究这些项目，我确实在这些项目的想法中看到了一些潜力。 因此，让我们更详细地关注这个无人机项目。

I decided to redesign this project, but this approach of using a "3D doodle had to go. With the original project design there was no math, there was no science, and there was no real use of technology either. Everything was just focused on the act of making a drone. It was a completely reactive in nature where STEM should apply the engineering and design process which is a well-planned and methodical approached to design. Therefore, after redesigning the project we started with this…. Here you can see that these students using specialized equipment such as calipers to take precise measurements. They then went on to make a rough draft of their design using a pencil and paper, before reviewing it, critiquing it, and then revising it. Finally, the students digitized their designs using a CAD program so they could print their designs using a 3D printer. Now you might say that this looks great, but as I mentioned before STEM should solve REAL-WORLD problems. **However, you might ask me how does this drone project address a legitimate need in society?**	我决定重新设计这个项目，但这种使用"3D 涂鸦"的方法必须放弃。 在最初的项目设计中，没有数学，没有科学，也没有真正使用技术。一切都集中在制造无人机上。这是一种完全被动的性质，STEM 应该应用工程和设计过程，这是一个精心策划和有条不紊的设计方法。因此，在重新设计项目后，我们从这个开始… 在这里，你可以看到这些学生使用卡尺等专业设备进行精确测量。然后，他们用铅笔和纸对自己的设计进行了粗略的起草，然后进行了审查、批评和修改。最后，学生们使用 CAD 程序将自己的设计数字化，这样他们就可以使用 3D 打印机打印自己的设计。 现在你可能会说这看起来很棒，但正如我之前提到的，STEM 应该解决现实世界的问题。 你可能会问我，这个无人机项目如何满足社会的合法需求?

Well not that long ago we had a major flood in Henan province and China had an interesting solution to the problem. It was an automated drone that could be deployed to restore 5G cell-service over a 50-square kilometer area for up to 5 hours, and this 1 drone was able to help rescue crews find, locate, and save thousands of people in the aftermath of the flood. Therefore, the idea of drone development does in fact solve a real-world problem. So, although the initial project design was poorly executed, there was value in the idea. The teacher just needed help to refine that idea and to develop the project in a more meaningful way.	不久前，河南省发生了一场大洪水，中国有一个有趣的解决方案。这是一种自动无人机，可以部署在 50 平方公里的区域内恢复 5G 蜂窝服务长达 5 小时。 这架无人机能够帮助救援人员在洪水过后找到、定位并拯救数千人。因此，无人机开发的想法实际上解决了一个现实世界的问题。 因此，尽管最初的项目设计执行不力，但这个想法还是有价值的。老师只是需要帮助来完善这个想法，并以更有意义的方式发展这个项目。

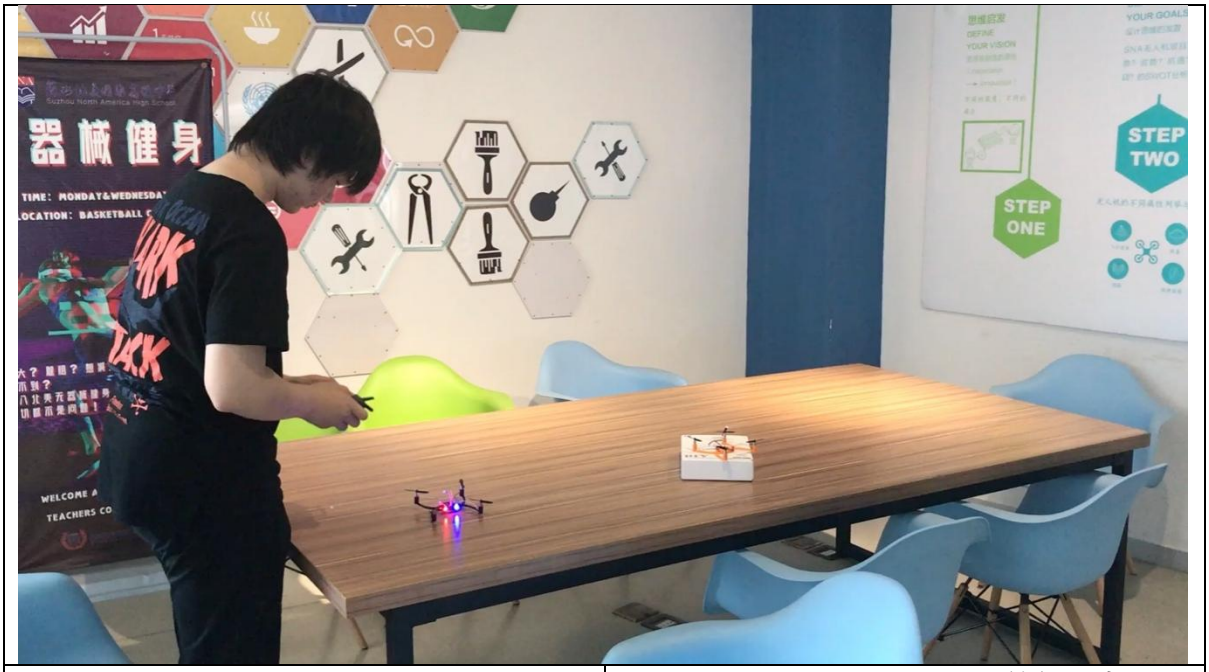


As such, after redesigning the project:

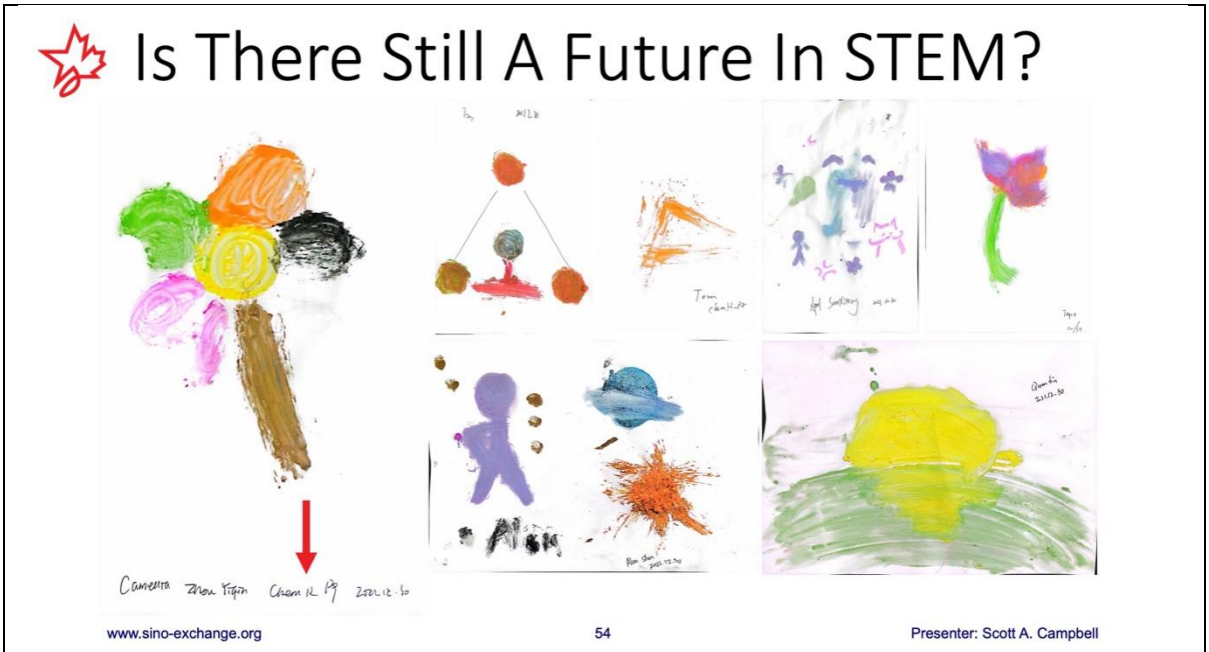
- Students were shown how to apply the "Engineering and Design Process" in an authentic way.
- While using specialized equipment such as calipers to take precise measurements which they would use when creating their drones.
- They created designs on paper, analyzed their ideas with their peers in a formal critique process, and revised their designs before digitizing these designs using a CAD program.
- So that they could use technologies such as 3D printers in authentic way to support the desired learning outcomes.
- And finally, they created a high-quality product that upholds the ideals of STEM education.

因此，在重新设计项目后：

- 向学生展示了如何以真实的方式应用"工程和设计流程"。
- 在使用卡尺等专业设备进行精确测量时，他们将在创建无人机时使用这些设备。
- 他们在纸上创作设计，在正式的批评过程中与同行分析他们的想法，并在使用 CAD 程序将这些设计数字化之前修改他们的设计。
- 以便他们能够以真实的方式使用 3D 打印机等技术来支持所需的学习成果。
- 最后，他们创造了一个高质量的产品，支持 STEM 教育的理想。

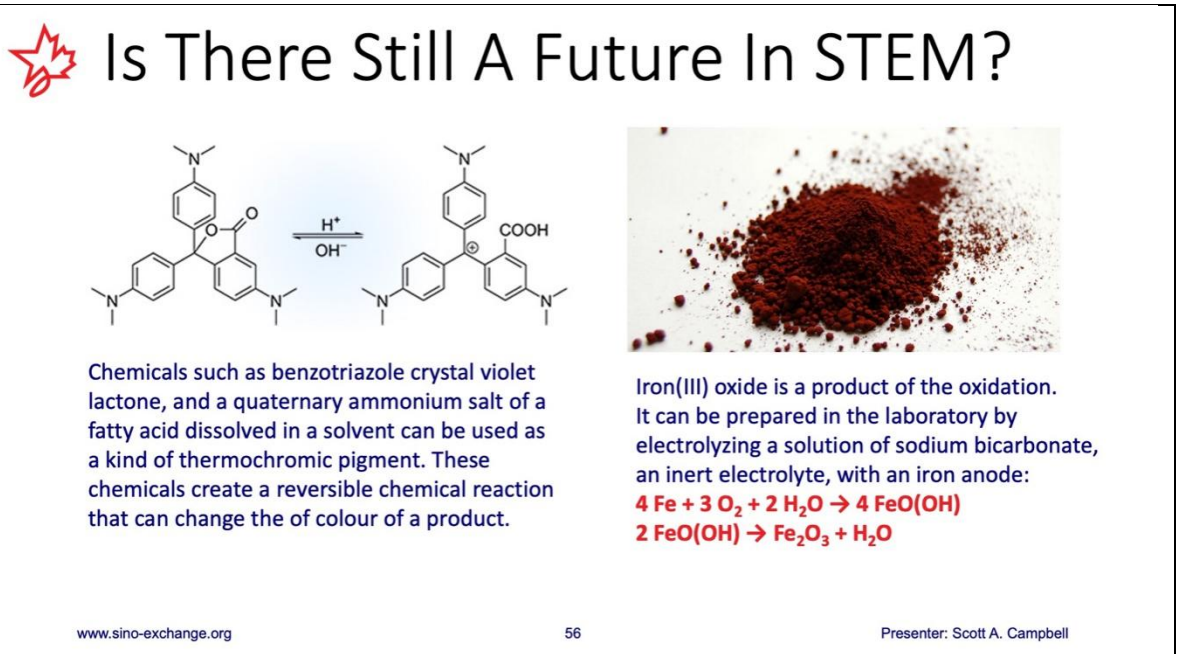


Now here is a quick video of a student's final projects. While it did use premade circuits, the drone itself was created by the student.	下面是一个学生期末项目的简短视频。虽然它确实使用了预制电路，但无人机本身是由该学生创造的。



Now what about this STEM project? What grade do you think this project was for? This was a grade 12 honors chemistry project where the students were learning about water resistant paints. Now you might be thinking that this activity isn't appropriate for that grade level. However, the school was proud of the results because they thought this was a good example of STEM education because the students had engaged in project-based learning.	现在这个 STEM 项目怎么样? 你认为这个项目的成绩是多少? 这是一个 12 年级的荣誉化学项目，学生们正在学习防水涂料。现在你可能会认为这个活动不适合那个年级。然而，学校为这一结果感到骄傲，因为他们认为这是 STEM 教育的一个很好的例子，因为学生们参与了基于项目的学习。

Here are some more images from that post, and you can see that these grade 12 students in a well-equipped chemistry lab creating paint using “CRAFT GLUE” and “COLOURED CHALK”, but we are probably asking ourselves “where is the chemistry”, and this brings us back to the idea of throwing teachers into a STEM program without any training or support! Afterall designing authentic STEM lessons is incredibly difficult. Especially if teachers have never work in industry before!	以下是该帖子中的更多图片，你可以看到，这些 12 年级的学生在一个设备齐全的化学实验室里用“手工胶水”和“彩色 CHALK”创作油漆，但我们可能在问自己“化学在哪里”，这让我们回到了让教师在没有任何培训或支持的情况下参加 STEM 项目的想法！毕竟，设计真正的 STEM 课程非常困难。尤其是如果老师以前从未在这个行业工作过的话！
Now I should state that this teacher was an amazing chemistry teacher when it came to teaching theoretical concepts; however, they had limited understanding of how to apply science to solve industrial problems in the real-world.	现在我应该指出，这位老师在教授理论概念方面是一位了不起的化学老师；然而，他们对如何在现实世界中应用科学来解决工业问题的理解有限。
Now there are so many ways that we could have made this project could be improved.	现在，我们有很多方法可以使这个项目得到改进。

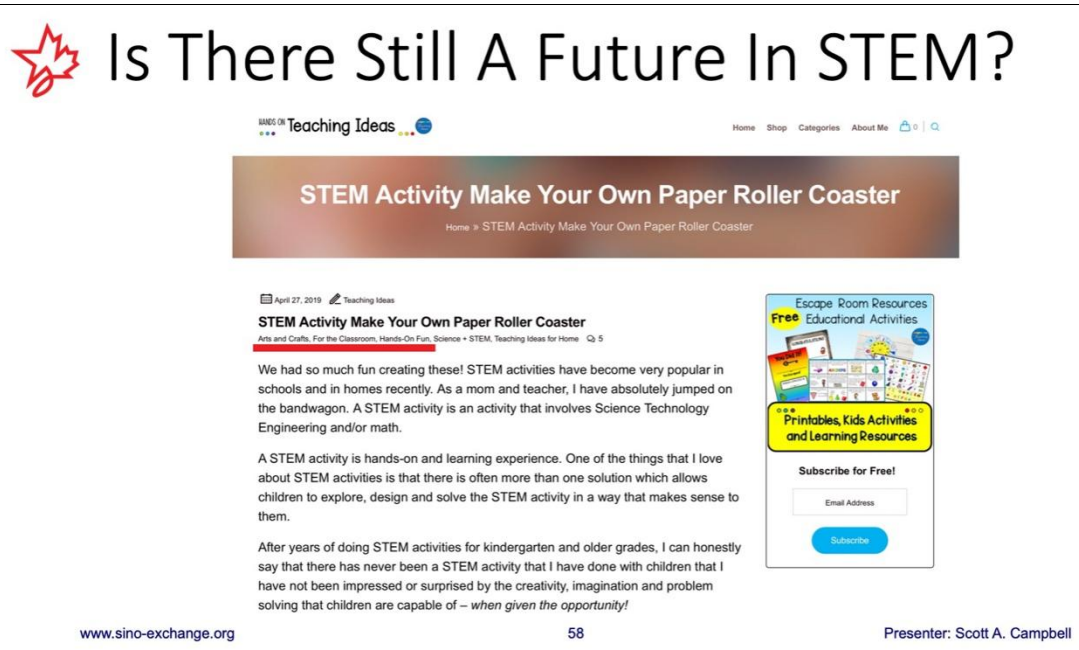


Here I have some examples of what we could have done instead. To the left I have reference to chemical compounds that would allow for a “Thermochromic” effect to be explored. That is when the colour of something changes due to temperature because of a reversable chemical reaction.	这里我有一些例子，说明我们本可以做些什么。在左边，我提到了可以探索“热致变色”效应的化合物。也就是说，由于可逆转的化学反应，某种东西的颜色会因温度而改变。
Next, on the right I have an example of how you can create “Ferric Oxide” to create a colour pigment. Now for reference “Ferric Oxide” is used to create cosmetic products such as BLUSH.	接下来，在右边我有一个例子，你可以创建“氧化铁”来创建一种彩色颜料。现在可供参考的是，“氧化铁”被用于生产化妆品，如腮红。
So, we already have a few options that we could use to improve this one project, **but let’s take this a little bit further!**	所以，我们已经有了一些可以用来改进这个项目的选项，但是让我们再深入一点！
Now that we have some pigments, we can then explore different chemical methods to convert these pigments into paint. First, we could look at how to use different chemical solutions to create a binding agent. Second, we could look to our past to learn how some of the greatest minds of our time created masterpieces such as the “**Sistine Chapel**”. At this time paints were made using pigments such as “Ferric Oxide” and “Lapis Lazuli” which were ground into fine powders. These pigments were then mixed	现在我们有了一些颜料，我们可以探索不同的化学方法将这些颜料转化为油漆。首先，我们可以研究如何使用不同的化学溶液来制造结合剂。其次，我们可以回顾我们的过去，了解我们这个时代一些最伟大的头脑是如何创造出杰作的，比如“西斯廷教堂”。当时，油漆是用“氧化铁”和“青金石”等颜料制成的，这些颜料被研磨成细粉末。然后将这些色素与蛋清混合，形成一种分子稳定的有机

with egg whites to create a molecularly stable, organic compound that could last for centuries. And in all honesty, these methods are actually superior to our current manufacturing processes in many ways. Therefore, this project could easily be redesigned in a way that would make it much more meaningful.	化合物，这种化合物可以持续几个世纪。 老实说，这些方法实际上在很多方面都优于我们目前的制造工艺。因此，这个项目可以很容易地进行重新设计，使其更有意义。

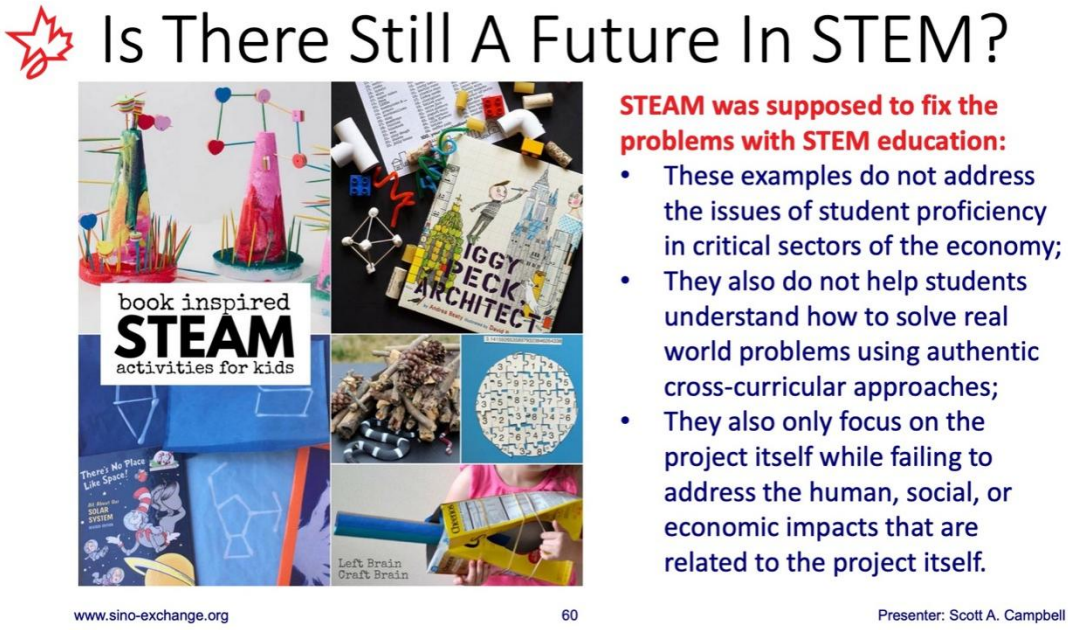
Now what about this project? Again, it's another social media post. This time for a grade 12 calculus project. This post indicated that the students were exploring the velocity of the marble using calculus, but realistically the math and the project are somewhat disassociated from one another. You don't really need to do the math to do the project, and you don't need to do the project to do the math. Therefore, these two aspects of the project are loosely co-related. **So, is this really STEM?** And I have seen this same roller-coaster project being used for very different age levels! Specifically in senior level calculus classes, and in grade 2 art classes as well which raises some serious questions! Are we developing projects that are age appropriate? And it's this kind of disconnect between the desired learning outcomes and project design is causing a lot of problems within STEM education.	现在这个项目怎么样? 同样，这是另一个社交媒体帖子。这次是 12 年级的微积分项目。这篇帖子表明，学生们正在使用微积分来探索大理石的速度，但实际上，数学和项目之间有些脱节。你真的不需要做数学来做这个项目，也不需要做这个项目来做数学。因此，项目的这两个方面是松散地相关的。 那么，这真的是 STEM 吗? 我见过同样的过山车项目被用于不同的年龄段！特别是在高年级的微积分课上，以及在二年级的艺术课上，这会引发一些严重的问题! 我们是否正在开发适合年龄的项目? 正是这种期望的学习成果和项目设计之间的脱节导致了 STEM 教育中的许多问题。

And here we have a website promoting this activity, and I am not disputing the quality of the website, the resources, or the validity the project itself, but I do want to draw you attention to something here in the corner….	在这里，我们有一个网站来宣传这项活动，我并不质疑网站的质量、资源或项目本身的有效性，但我确实想提醒你注意角落里的一些东西…



It indicates “Arts and Crafts”, “Hands on Fun”, and that’s how this project is being described. But when we look at the driving forces behind STEM, it’s about ensuring continued innovation strategic sectors that were critical to the economy; Therefore, I will reiterate that STEM was created to ensure continued economic prosperity of the nation, which in-turn plays a pivotal role in protecting our national sovereignty. It was never to create hands-on activities for students to have fun in class!	它表示“工艺美术”，“动手娱乐”，这就是这个项目的描述。但当我们审视 STEM 背后的驱动力时，它是关于确保对经济至关重要的战略部门持续创新；因此，我要重申，STEM 的创建是为了确保国家的持续经济繁荣，而这反过来又在保护我们的国家主权方面发挥着关键作用。这从来都不是为了让学生在课堂上玩得开心而创造动手活动！
So how did we get to here?	那么我们是怎么到这里的呢？
How did STEM deviate so far from our primary objectives?	STEM 是如何偏离我们的主要目标的？

Just look these books: “STEAM Creations”, and “book inspired STEAM activities for kids”. Again, I am not criticizing the book or the author, but I do want you to look at these examples of what people are starting to call STEM or STEAM education, but if you look here it says, “Craft Brain”. All these books and activities are representative of arts and crafts, and not STEM.	看看这些书：“STEAM 创意”和“以书为灵感的 STEAM 儿童活动”。同样，我不是在批评这本书或作者，但我确实希望你看看这些人们开始称之为 STEM 或 STEAM 教育的例子，但如果你看这里，它会说，“工艺的大脑”。所有这些书籍和活动都是艺术和工艺的代表，而不是 STEM。



Now STEAM was supposed to fix the problems that we talked about earlier in this presentation…
However:

- These examples do not address the issues of student proficiency in critical sectors to the economy.
- While also not helping students to understand how to solve real world problems using authentic cross-curricular approaches.
- While also only focusing on the project itself while failing to address the human, social, or economic impacts that are related to the project.

And as when we look at this list of shortcomings, they represent all the issues were made of the original STEM education framework; Therefore, it's very clear that STEAM didn't solve the problem!

The reality is that the introduction of STEAM only made things worse!

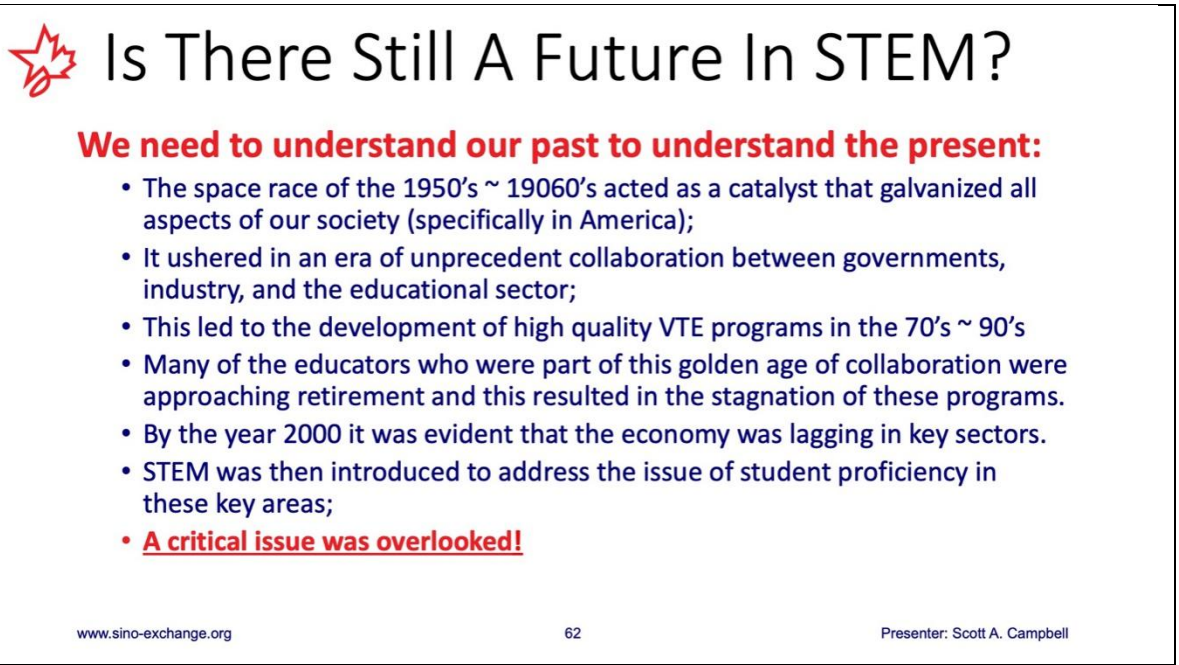
现在 STEAM 应该解决我们在本演示中早些时候谈到的问题…
但是：

- 这些例子没有解决学生在经济关键部门的熟练程度问题。
- 同时也不能帮助学生理解如何使用真实的跨课程方法解决现实世界中的问题。
- 同时也只关注项目本身，而没有解决与项目相关的人类、社会或经济影响。

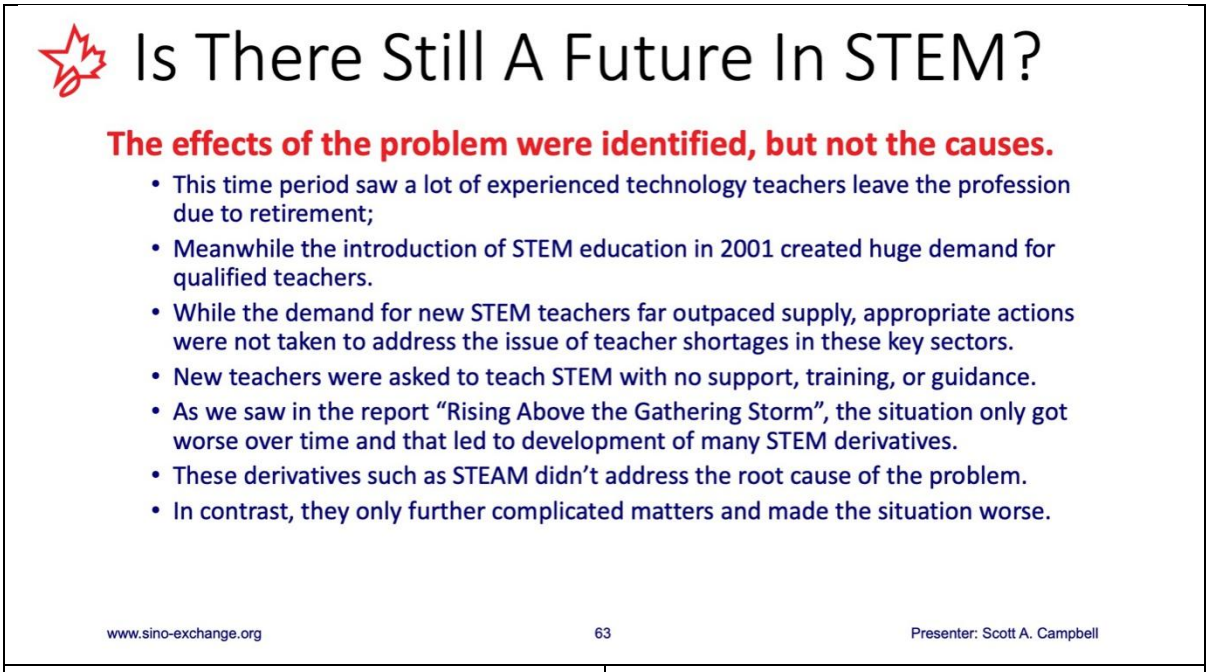
当我们看到这份缺点清单时，它们代表了所有由原始 STEM 教育框架构成的问题；因此，很明显，STEAM 并没有解决问题！

事实是，STEAM 的引入只会让事情变得更糟！

So how did we get here? How did we reduce rigorous academic programs to nothing more than glorified art projects?	那我们是怎么来的? 我们是如何将严谨的学术项目简化为美化的艺术项目的?

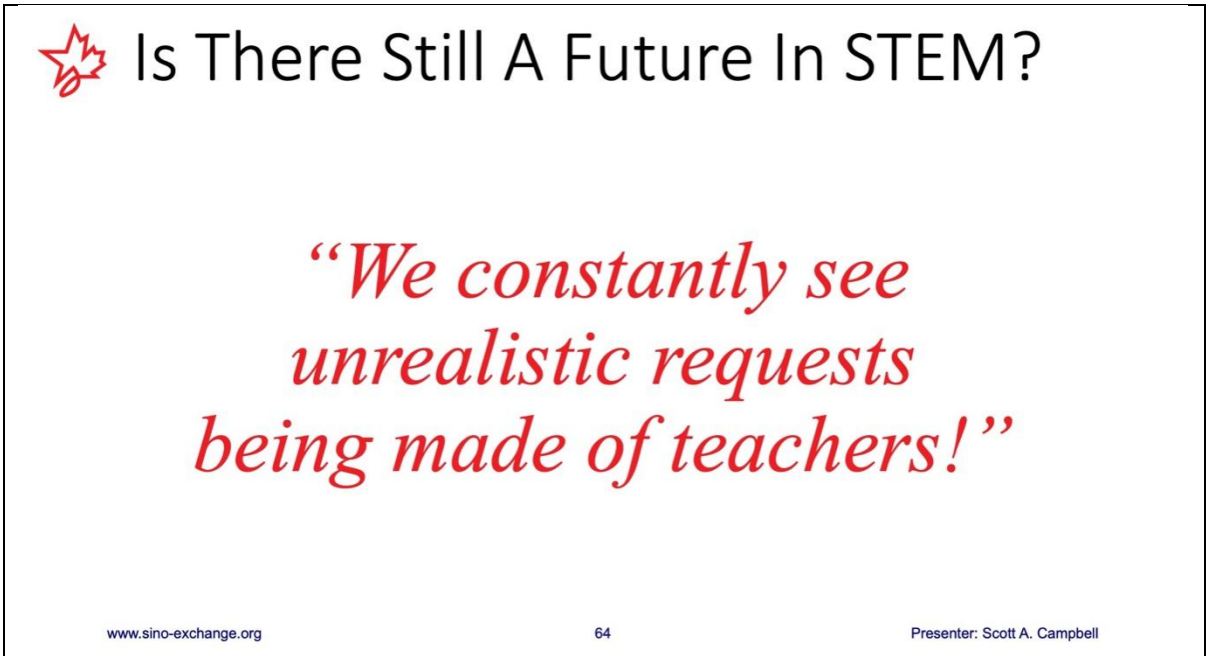


To understand how we got here we need to understand a number cause and effect relationships that are happening within our society. We need understand our own history. As I've already mentioned, the space race of the 1950's ~ 1960's acted as a catalyst that galvanized all aspect of our society (Specifically in America), and it ushered in an era of unprecedent collaboration between governments, industry, and the educational sector. This led to the development of high-quality VTE programs in the 1970's, 80's and 90's; However, by the late 90's many of the educators were part of this golden age of collaboration were approaching retirement age and this in-turn led to the stagnation of these programs. Moreover, by the year 2000 it was evident that innovation was slowing, and that the economy was lagging in key sectors. Therefore, STEM was introduced to address the issue of student proficiency in these key areas; **however, a critical issue was overlooked!**	为了了解我们是如何走到这一步的，我们需要了解我们社会中正在发生的一些因果关系。我们需要了解我们自己的历史。 正如我已经提到的，20 世纪 50 年代至 60 年代的太空竞赛起到了催化剂的作用，激发了我们社会的方方面面（特别是在美国），它开创了政府、工业和教育部门之间前所未有的合作时代。 这导致了 20 世纪 70 年代、80 年代和 90 年代高质量 VTE 课程的发展；然而，到了 90 年代末，许多参与合作黄金时代的教育工作者正接近退休年龄，这反过来又导致了这些项目的停滞。此外，到 2000 年，创新明显放缓，经济在关键部门落后。因此，引入 STEM 是为了解决学生在这些关键领域的熟练程度问题；然而，一个关键问题被忽略了！



The root cause of these problems was not identified. We were quick to determined that student proficiency was trailing in key sectors to the economy, but we never stopped to ask why this was happening. Let me explain. The late 90's onwards saw a lot of experienced technology teachers leave the profession due to retirement. Meanwhile the introduction of STEM education in 2001 created huge demand for qualified teachers, and this shortage was only exasperated by the effect of numerus teachers simultaneously leaving the profession. Moreover, while the demand outpaced the supply of qualified teachers, appropriate actions were not taken to address the issue of teacher shortages in these key sectors. As a result, new teachers were often asked to teach STEM with little support, training, or guidance, and as we saw in the report "Rising Above the Gathering Storm", we didn't achieve our initial goals with the development of STEM education, and the	这些问题的根本原因尚未查明。 我们很快就确定，学生的熟练程度在经济的关键部门落后，但我们从未停下来问为什么会发生这种情况。 让我解释一下。 90 年代末以后，许多经验丰富的技术教师因退休而离职。与此同时，2001 年 STEM 教育的引入对合格教师产生了巨大的需求，而这种短缺只因大量教师同时离职而加剧。此外，尽管需求超过了合格教师的供应，但没有采取适当行动来解决这些关键部门的教师短缺问题。 因此，新教师经常被要求在几乎没有支持、培训或指导的情况下教授 STEM，正如我们在《超越聚集风暴》报告中看到的那样，我们没有实现 STEM 教育发展的最初目标，而且随着时间的推移，情况

situation only got worse with time, and this led to development of numerous STEM derivatives. However, as we are starting to see. These derivatives such as STEAM didn't address the root-cause of the problem. They only served to further complicate matters and made things worse.	只会变得更糟，这导致了许多 STEM 衍生物的开发。然而，正如我们开始看到的那样。STEAM 等衍生产品并没有解决问题的根本原因。他们只会使事情进一步复杂化，使事情变得更糟。



To summarize, STEM was introduced to address a massive need in our society… and we see this burden being placed on teachers by local governments. However, teachers know all too well, they are seldomly given the support, guidance, or resources that they need to fulfill these kinds of requests.	总之，STEM 的引入是为了满足我们社会的巨大需求……我们看到地方政府给教师带来了这种负担。 然而，老师们非常清楚，他们很少得到满足这些要求所需的支持、指导或资源。
Moreover, unlike what we saw happen in the 50's and 60's, our current situation doesn't have a galvanizing catalyst to help foster collaboration between these three sectors: government, industry, and education. As a result, anything that involved hands on approaches to teaching and learning started getting branded as STEM education, and this perpetuated a simplistic or superficial understanding of STEM education to take hold.	此外，与我们在 50 年代和 60 年代看到的情况不同，我们目前的情况没有一个激励的催化剂来帮助促进这三个部门之间的合作：政府、工业和教育。因此，任何涉及实际教学方法的东西都开始被打上 STEM 教育的烙印，这使人们对 STEM 教育过于简单或肤浅的理解根深蒂固。
Furthermore, as a result of the confusion surrounding the development of STEM education corporations started capitalizing on the business opportunities that were growing in educational sector, and while some companies created completely new educational resources, other companies simply rebranded existing products to	此外，由于围绕 STEM 教育发展的混乱，企业开始利用教育部门不断增长的商机，虽然一些公司创造了全新的教育资源，但其他公司只是重新命名现有产品，以利用一个成熟的市场。

capitalize on a market that was ripe for the taking. Which brings me to my next topic!	这就引出了我的下一个话题!

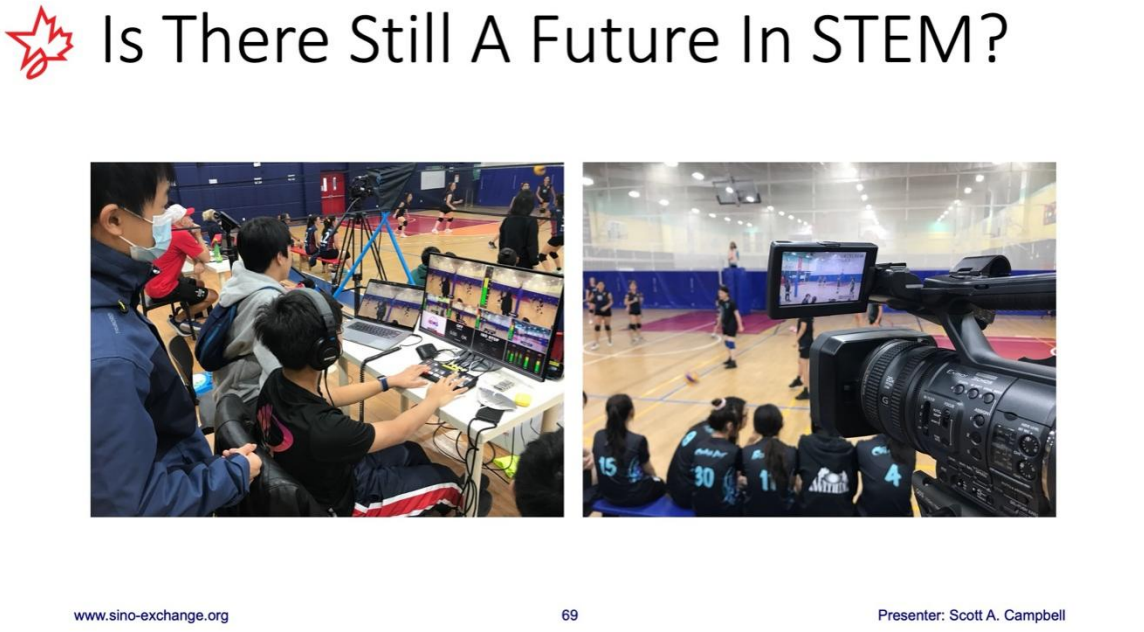
Now as we've already seen, STEM was introduced to spur innovation by having students develop rigorous academic concepts prior to attending specialized university programs, and this would better prepared students for an increasingly competitive global economy. Moreover, this would also help to strengthen and improve the economy. However, in-order for this to happen the educational sector would need to develop curricula that could apply complex concepts in an authentic way, while also developing a sustainable educational model. However, the only way to do this properly is to identify the desired learning outcomes and then design a program of study around transferable concepts that can transcend the test of time.	现在，正如我们已经看到的那样，STEM 的引入是为了刺激创新，让学生在参加专业大学项目之前培养严格的学术概念，这将使学生更好地为竞争日益激烈的全球经济做好准备。此外，这也将有助于加强和改善经济。然而，为了实现这一点，教育部门需要制定能够以真实的方式应用复杂概念的课程，同时还要制定可持续的教育模式。然而，正确做到这一点的唯一方法是确定所需的学习结果，然后围绕可以超越时间考验的可转移概念设计一个学习计划。
However, the rush to develop programs has often resulted in technology purchases being made in haste, and this results in the learning outcomes being shaped around how to use a specific piece of technology instead the authentic use of that technology!	然而，急于开发程序往往导致匆忙购买技术，这导致学习结果围绕着如何使用特定的技术而不是真正使用该技术而形成!
As such, the advent of STEM education saw thousands of products come to market.	因此，STEM 教育的出现见证了成千上万的产品进入市场。然而，这些产品中的

however, many of these products focused solely on the act of making a project and often failed to address key learning outcomes in the process! And as we saw earlier this was a large contributing factor that led to many of the criticisms against STEM in the first place. Therefore, if we want to prepare students for the world of tomorrow, we need to act today. We need to focus on developing authentic programs of study that are designed around sound educational practices and to illustrate this point I am going to show you some examples of STEM programs from 30 years to illustrate that quality curriculum development can withstand the test of time. Therefore, if we look past the fads, we can develop sustainable programs of study that are fiscally responsible as they maximize the lifecycle of the equipment that is needed to run the program which increases the Return on Investment while simultaneously developing more stability in the curriculum that targets the most rigorous academic standards.	许多只专注于项目的制定，并且往往未能解决过程中的关键学习成果！正如我们早些时候看到的，这是一个很大的促成因素，最初导致了许多对 STEM 的批评。因此，如果我们想让学生为明天的世界做好准备，我们就需要今天就行动起来。 我们需要专注于开发围绕良好教育实践设计的真实学习计划，为了说明这一点，我将向您展示 30 年来 STEM 计划的一些例子，以说明高质量的课程开发能够经得起时间的考验。因此，如果我们超越时尚，我们可以制定可持续的学习计划，这些计划在财政上是负责任的，因为它们最大限度地延长了运行该计划所需设备的生命周期，从而提高了投资回报率，同时也提高了课程的稳定性，以达到最严格的学术标准。

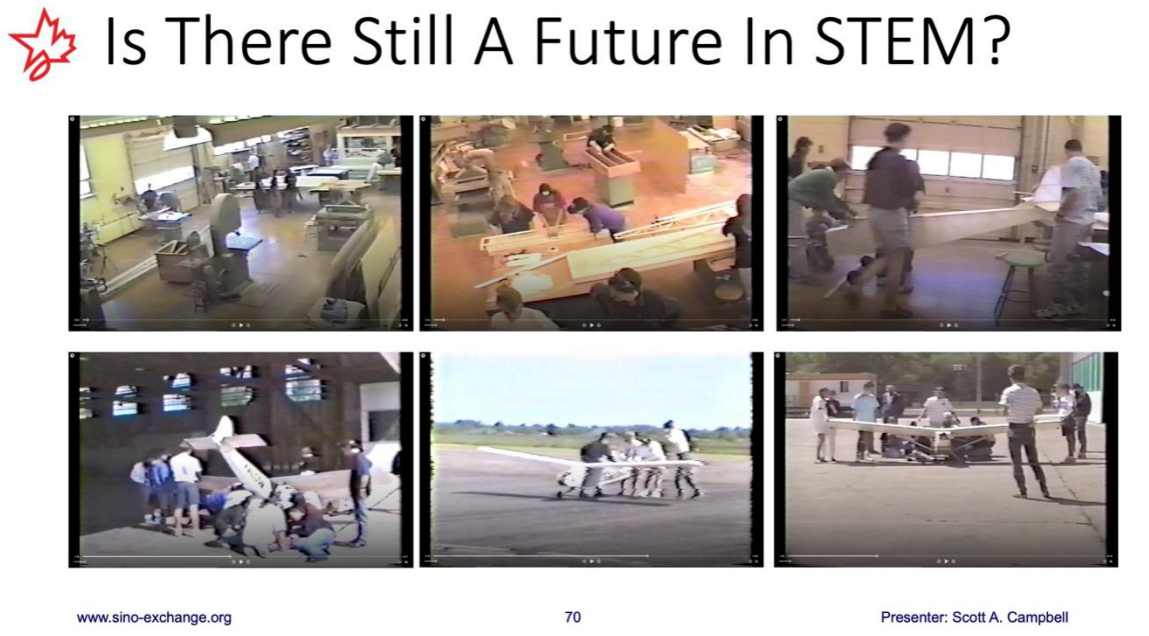
With said I want to talk about the idea of fads vs. enduring knowledge. Here we have a school is showcasing one of their new STEM products. A racetrack for CO_2 dragster, and this is a project that I personally really like! It' s also one of the best-selling project kits from companies such as High-Genius and PITSCO. While some STEM products have only been around for a few years, t**his one product has been sold in the United States for close to 70 years now!**	说到这里，我想谈谈时尚与持久知识的概念。在这里，我们有一所学校正在展示他们的一种新 STEM 产品。CO_2 牵引车的赛道，这是我个人非常喜欢的项目！它也是 High Genius 和 PITSCO 等公司最畅销的项目工具包之一。虽然一些 STEM 产品只存在了几年，但这一产品在美国已经销售了近 70 年！
For example, here is the PITSCO guide to education from the 1990's that I used as a student, but CO2 racers were popular much earlier than that!	例如，这是我在学生时代使用的 20 世纪 90 年代的 PITSCO 教育指南，但二氧化碳赛车的流行要早得多！
In these final examples from the mid 1950's. These DIY kits were popularized at the time as they inspired and got young Americans interested in aerodynamics and propulsion during the US-Soviet space race. Now although this was a little before my time, my father's generation would build these rocket propelled cars and race them in large tournaments, some of which were even held at a national level.	在这些 1950 年代中期的最后例子中。在美苏太空竞赛期间，这些 DIY 套件激发了美国年轻人对空气动力学和推进的兴趣，并在当时得到了普及。 现在，尽管这比我的时代早了一点，但我父亲那一代人会制造这些火箭推进的汽车，并在大型锦标赛中比赛，其中一些甚至在全国范围内举行的。

Here we can see the influence of rocket propelled vehicles as a major driving force in society to this very day. From development of the fastest land-based vehicle, which was essentially a rocket on wheels! To our modern-day mag-lev technologies. All these advancements came from the study propulsion and aerodynamics.	在这里，我们可以看到火箭推进车辆作为一种主要的社会驱动力的影响，直到今天。 从开发最快的陆基飞行器开始，它本质上是一枚带轮子的火箭! 我们的现代磁悬浮技术。 所有这些进步都来自于对推进和空气动力学的研究。

Therefore, the idea of rocket propulsion and aerodynamics are ideas that can transcend time, and although some of the methods that we use vary over time, the core learning objectives - **that is the curriculum at the heart of the project** - has remained the same, and I think that this is an important thing to consider when developing sustainable STEM programs. We need to look at the desired learning outcomes and be careful not be distracted by new fads or technologies.	因此，火箭推进和空气动力学的概念可以超越时间，尽管我们使用的一些方法会随着时间的推移而变化，核心学习目标——即项目核心的课程——保持不变，我认为这是开发可持续 STEM 项目时需要考虑的一件重要事情。我们需要关注期望的学习结果，注意不要被新的时尚或技术分散注意力。
So, with that in mind, I want to show you some examples of what our technology programs looked like in the 1990's just to illustrate this point.	因此，考虑到这一点，我想向大家展示一些 20 世纪 90 年代我们的技术项目的例子，只是为了说明这一点。
Here we have an example of this project back in 1993, again this is before STEM even existed, but you can really see the cross-curricular nature that programs that school's had back then. Not only did the students design, build, and test their racers, they also dealt with the logistics of setting up tournaments, broadcasting, and providing live commentary of the event.	在这里，我们有一个 1993 年这个项目的例子，同样是在 STEM 存在之前，但你可以真正看到当时学校的项目具有跨课程性质。学生们不仅设计、建造和测试了他们的赛车手，还处理了设立比赛、广播和提供赛事现场解说的后勤工作。

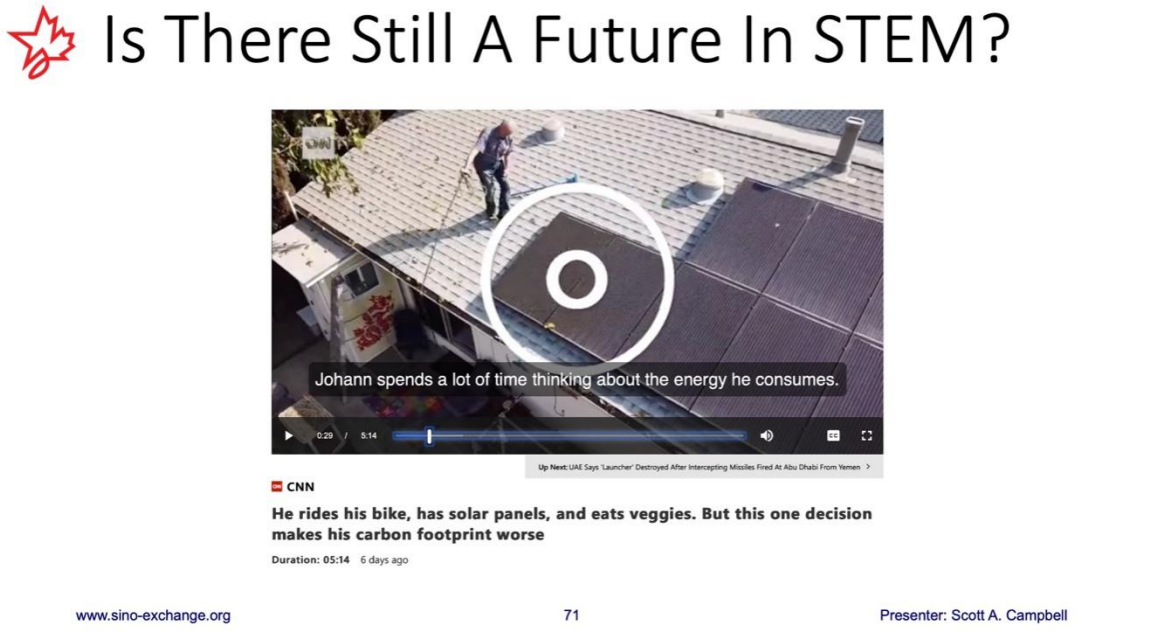


Now fast forward thirty years. I wanted to start a broadcasting program post COVID to help parents be part of their child's school community again. Therefore, I pulled out my old camera equipment out of storage. Now most of this equipment was purchased in 2002 when I started my first company, so this isn't state of art equipment. however, all the schools' high-end private schools that attended this tournament were amazed at how sophisticated the set up was. Everyone commented that "they had never seen anything like this before!" And that shocked me! Think about it! How did we degrees so far, and why is it that I am consistently looking to our past to find inspiration for our future? Particularly in the fast-moving fields of science and technology!	现在快进三十年。 我想在新冠肺炎疫情后开办一个广播节目，帮助家长再次成为孩子学校社区的一部分。因此，我把我的旧相机设备从仓库里拿了出来。现在，这些设备大多是在 2002 年我创办第一家公司时购买的，所以这不是最先进的设备。然而，所有参加此次锦标赛的学校的高端私立学校都对其设施的复杂程度感到惊讶。每个人都评论说"他们以前从未见过这样的事情！" 这让我很震惊! 想想看! 到目前为止，我们是如何获得学位的？为什么我一直在回顾我们的过去，为我们的未来寻找灵感？尤其是在快速发展的科学技术领域!



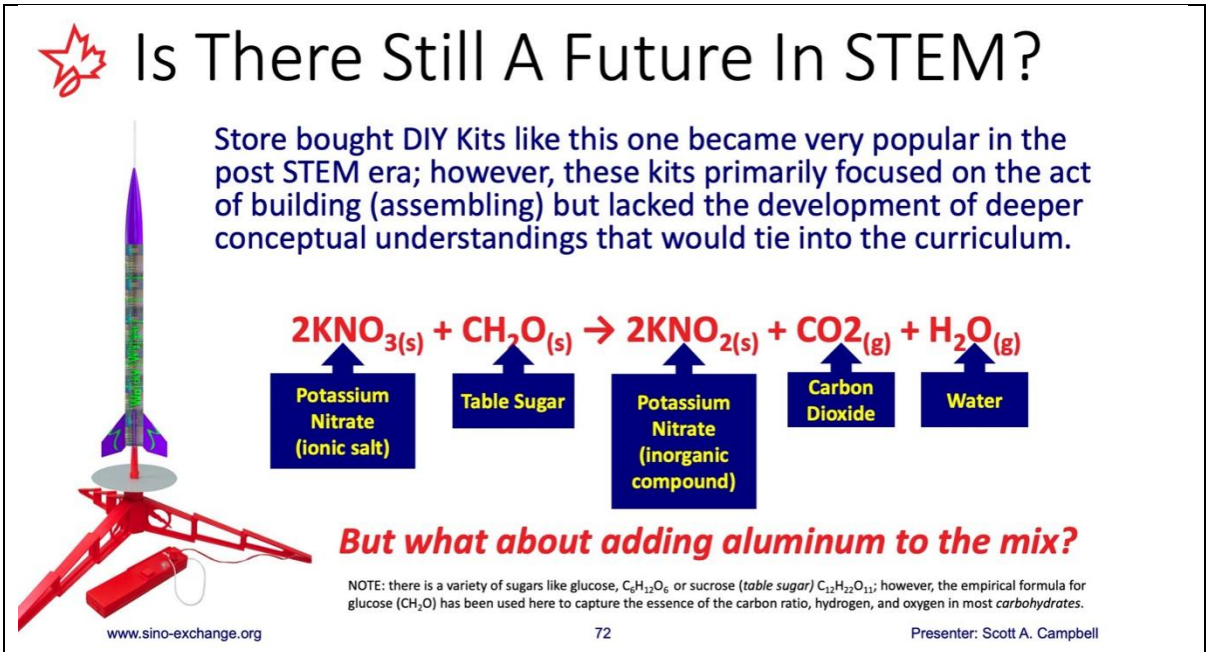
But that is not the only example I can give you!	但这并不是我能给你的唯一例子!
So, I want to take you back to another class project from the mid 90's. This was an amazing aviation project that my teacher John Perkins designed in collaboration with an aerospace engineer. We spent the entire term learning the math and science of aviation, manufacturing techniques, electronics, and control systems, and at the end of the day, we had built a scale model that we flew out of the local airport. This project is a great example of what an interdisciplinary approach to real-world lessons which offer rigorous academic concepts would look like. Moreover, I think that is what the government was looking for when Judith Ramaley introduced STEM back in 2001.	所以，我想带你回到 90 年代中期的另一个课堂项目。这是我的老师约翰·帕金斯与一位航空航天工程师合作设计的一个令人惊叹的航空项目。我们整个学期都在学习航空、制造技术、电子和控制系统的数学和科学，最后，我们建立了一个从当地机场起飞的比例模型。这个项目是一个很好的例子，说明了提供严格学术概念的跨学科的现实世界课程会是什么样子。此外，我认为这正是 Judith Ramaley 在 2001 年引入 STEM 时政府所寻求的。
So, when I started developing aviation projects for STEM programs here in China I did exactly what John did almost 30 years earlier. I reached out to industry professionals and started working with an aerospace engineer from the **Nanjing University of Aeronautics and Astronautics.** This really helped me as a teacher, as it helped me to design	所以，当我开始在中国为 STEM 项目开发航空项目时，我做的正是约翰 30 年前所做的。我接触了行业专业人士，并开始与南京航空航天大学的一位航空航天工程师合作。这真的帮助了我作为一名教师，因为它帮助我设计了脚手架项目，使将航空引入高中课程成为一个可行的现实。

scaffolded projects that would make introducing aviation into high-school programs a viable reality. But we don't see this kind of collaboration happening anymore between government, industry professionals, and teachers anymore, and this has really been the detriment of STEM education.	但我们再也看不到政府、行业专家和教师之间的这种合作了，这真的是对 STEM 教育的损害。



Now as I have mentioned before, STEM should be real-world problems.	正如我之前提到的，STEM 应该是现实世界中的问题。
So, you might be thinking, "how does the study of aviation address real world problems?" Well, recently I came across this news story on CNN which illustrated this idea perfectly.	所以，你可能会想，"航空研究如何解决现实世界中的问题？"最近，我在美国有线电视新闻网上看到了这个新闻故事，它完美地说明了这个想法。
Johann wanted to know if his life choices were having a positive effect on addressing climate change, so he contacted CNN for help. Now Johann has a very healthy lifestyle. He eats mostly vegetables, rides his bike everywhere, and has installed solar panels on his roof. Based on all these factors his carbon footprint is about 40% less than the average American; however, there is one choice that he makes negates all his other life-style choices.	约翰想知道他的生活选择是否对应对气候变化有积极影响，所以他联系了美国有线电视新闻网寻求帮助。现在约翰的生活方式非常健康。他主要吃蔬菜，到处骑自行车，还在屋顶上安装了太阳能电池板。基于所有这些因素，他的碳足迹比普通美国人少 40%左右；然而，他做出的一个选择否定了他所有其他的生活方式选择。
Every year Johann returns to the Netherlands to visit his family. As we can see in this example, all the choices that he has made an individual were dwarfed in comparison to one thing that was out of his control. The emissions from commercial aviation! Therefore, this idea researching aerodynamics **HAS and WILL** continue to be important for years to come.	约翰每年都会回到荷兰探亲。正如我们在这个例子中看到的那样，与一件他无法控制的事情相比，他个人所做的所有选择都相形见绌。商业航空的排放！因此，研究空气动力学的这个想法在未来几年里一直很重要。

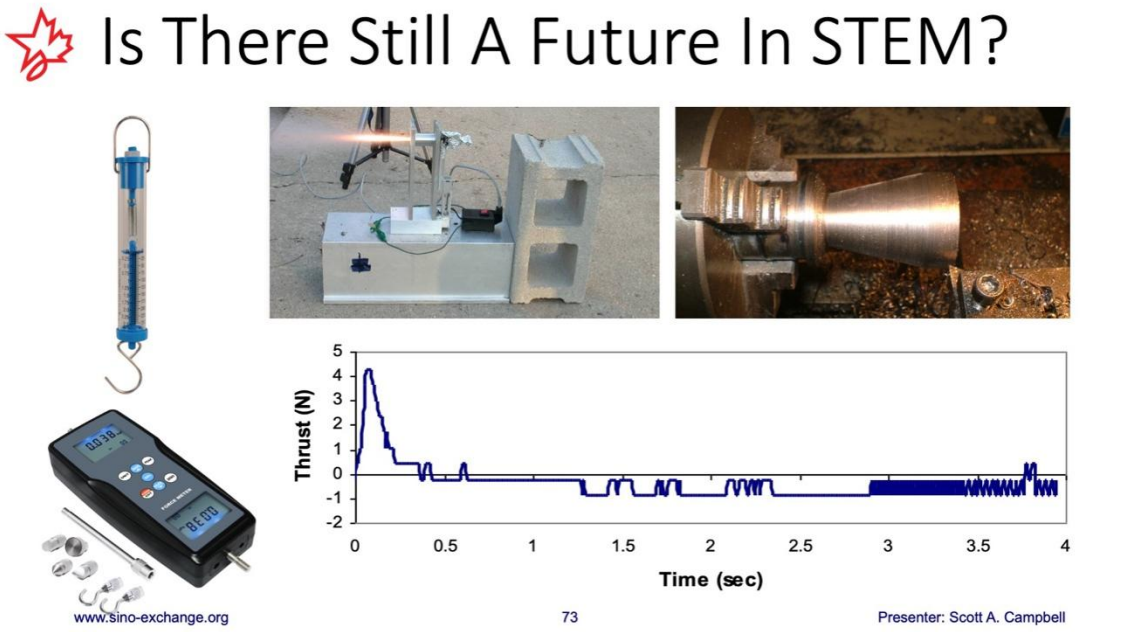
And that leads me to my next example…	这就引出了我的下一个例子…



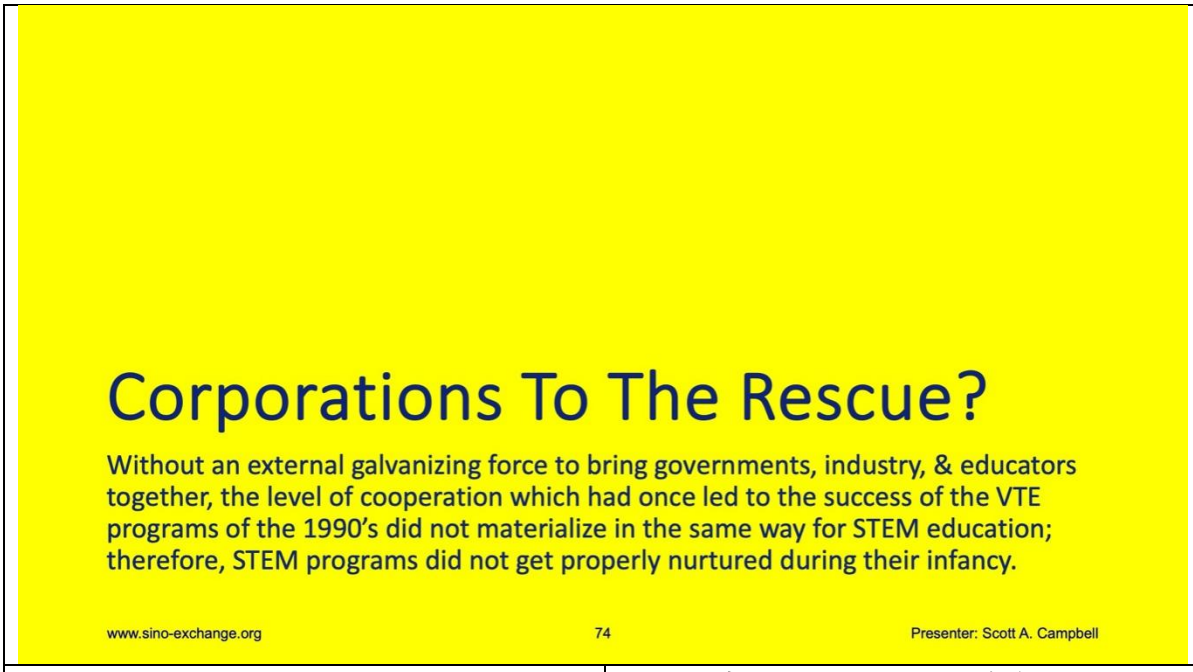
While DIY kits provide educators with easy ready-made projects that can be implemented with little to no preparation. These kits tend to offer very little towards achieving the desired learning outcomes of established curricula. However, rocketry has so many wonderful grade-level extensions for senior school students.	而 DIY 工具包为教育工作者提供了简单现成的项目，这些项目可以在几乎没有准备的情况下实施。这些工具包往往对实现既定课程的预期学习成果提供的帮助微乎其微。然而，火箭技术为高中生提供了许多精彩的年级扩展。
Drawing inspiration from my experience from 90's I can speak the scientific value that model rockets can have. Take this for example:	从我 90 年代的经历中汲取灵感，我可以谈论模型火箭的科学价值。举个例子:
Here is a balanced chemical equation for a combustion-based reaction. Now if you are not overly familiar with chemistry let me explain what is happening here. First, we have potassium nitrate or fertilizer, and this is mixed with regular table sugar. If this chemical mixture does not encounter a flame, it's relatively stable. however, it's capable of creating a powerful combustion based chemical reaction that will create a large amount of thrust.	以下是基于燃烧的反应的平衡化学方程式。现在，如果你对化学还不太熟悉，让我来解释一下这里发生了什么。首先，我们有硝酸钾或肥料，这是与普通食糖混合的。如果这种化学混合物没有遇到火焰，它是相对稳定的。然而，它能够产生强大的基于燃烧的化学反应，从而产生大量的推力。
During combustion, this chemical reaction will result in the formation of an inorganic salt, carbon dioxide, and water. Now as an instructor I wouldn't give my student the	在燃烧过程中，这种化学反应将导致无机盐、二氧化碳和水的形成。现在，作为一名教师，我不会给我的学生一个平衡的化学方程式。

balanced chemical equation. Instead, I would start by reviewing how to balance a chemical equation, and then have my students balance this equation on their own before checking their work and moving on. Then in-order to create the most efficient rocket fuel students would need to determine the molar mass of each compound so that they can determine the correct ratio of each.	相反，我会从复习如何平衡一个化学方程式开始，然后让我的学生在检查他们的工作并继续前进之前，自己平衡这个方程式。然后，为了制造出最有效的火箭燃料，学生们需要确定每种化合物的摩尔质量，以便确定每种物质的正确比例。
With the math completed they would then be ready to create their own rocket fuel.	计算完成后，他们就可以制造自己的火箭燃料了。
Now as it stands this project would have them apply chemistry in an authentic way. However, it still wouldn't have the students apply the scientific method, and I have a perfect way to address that problem.	现在，这个项目将让他们以一种真实的方式应用化学。然而，它仍然不会让学生应用科学的方法，我有一个完美的方法来解决这个问题。
I would like you to think about what would happen if we added aluminum to the mix? Would it improve your rockets performance? And what evidence could up us to support your claim?	我想让你想想如果我们在混合物中加入铝会发生什么？它会提高你的火箭性能吗？有什么证据可以支持你的说法？
In this example students would need to formulate a hypothesis that we could then go on and test. Now in theory adding something that is not necessary to balance the chemical reaction isn't recommended. however, adding Aluminum to rocket fuel is an exception to that rule.	在这个例子中，学生需要制定一个假设，然后我们可以继续测试。现在理论上不建议添加一些不必要的东西来平衡化学反应。然而，在火箭燃料中添加铝是一个例外。
Let me tell you a bit more information about this phenomenon.	让我告诉你更多关于这一现象的信息。
In the early 1950's Keith Rumbel and Charles Henderson conducted a series of experiment where they added Aluminum to conventional rocket fuels. The results of their experiments indicated a dramatic increase in the exit velocity of the combustion gases. So much so that this brought solid-fuel rockets into similar performance levels as liquid fuels that used kerosene and liquid oxygen.	20 世纪 50 年代初，Keith Rumbel 和 Charles Henderson 进行了一系列实验，在常规火箭燃料中添加铝。他们的实验结果表明，燃烧气体的出口速度显著增加。这使得固体燃料火箭的性能水平与使用煤油和液氧的液体燃料相似。

Due to their research into chemical propulsion methods the US Navy was able to significantly increase the range of ballistic missiles and sub-orbital rockets. Now because this was a bit of a trick scenario, almost every student's hypothesis will be disproven by the experiment. However, this will give them a great opportunity to conduct some internet research, and students should be able to find the answer to this question as the initial research has been declassified and can be found easily on the internet. However, how would you test such a hypothesis?	由于他们对化学推进方法的研究，美国海军能够显著增加弹道导弹和亚轨道火箭的射程。 现在，因为这是一个有点技巧的场景，几乎每个学生的假设都会被实验证明是错误的。然而，这将给他们一个很好的机会进行一些互联网研究，学生们应该能够找到这个问题的答案，因为最初的研究已经解密，可以很容易地在互联网上找到。然而，你将如何检验这样的假设？



In the 1990's we had to use analog test equipment; however, now we can use digital force meters which opens a world of possibilities. Now, we can now easily record and export precise data from our experiments directly to the computer which makes it even easier to do this kind of experiment now than it was thirty years ago. Here you can see what a simple set up for testing home-made rocket engines would look like in this photo. And finally, if your school has a metal shop, which mine did, you can even manufacture your own rocket engines using a small metal lathe. Therefore, you can see from these examples, when you develop a fully cross-circular approach to teaching and learning, your projects will last longer, and this will lower your hourly cost of instruction. Moreover, each project will explore the core curriculum in far more depth, and this type of in-depth and inquiry-based exploration. That's what's going to make students more competitive in the global economy.	在 20 世纪 90 年代，我们不得不使用模拟测试设备；然而，现在我们可以使用数字测力仪，这打开了一个充满可能性的世界。 现在，我们可以很容易地将实验中的精确数据直接记录和导出到计算机上，这使得现在做这种实验比三十年前更容易。 在这里，你可以看到这张照片中测试自制火箭发动机的简单设置是什么样子的。最后，如果你的学校有一家金属店，就像我的学校一样，你甚至可以用一台小型金属车床制造自己的火箭发动机。 因此，你可以从这些例子中看到，当你开发出一种完全跨循环的教学方法时，你的项目将持续更长的时间，这将降低你的每小时教学成本。 此外，每个项目都将对核心课程进行更深入的探索，以及这种深度的、基于探究的探索。 这将使学生在全球经济中更有竞争力。



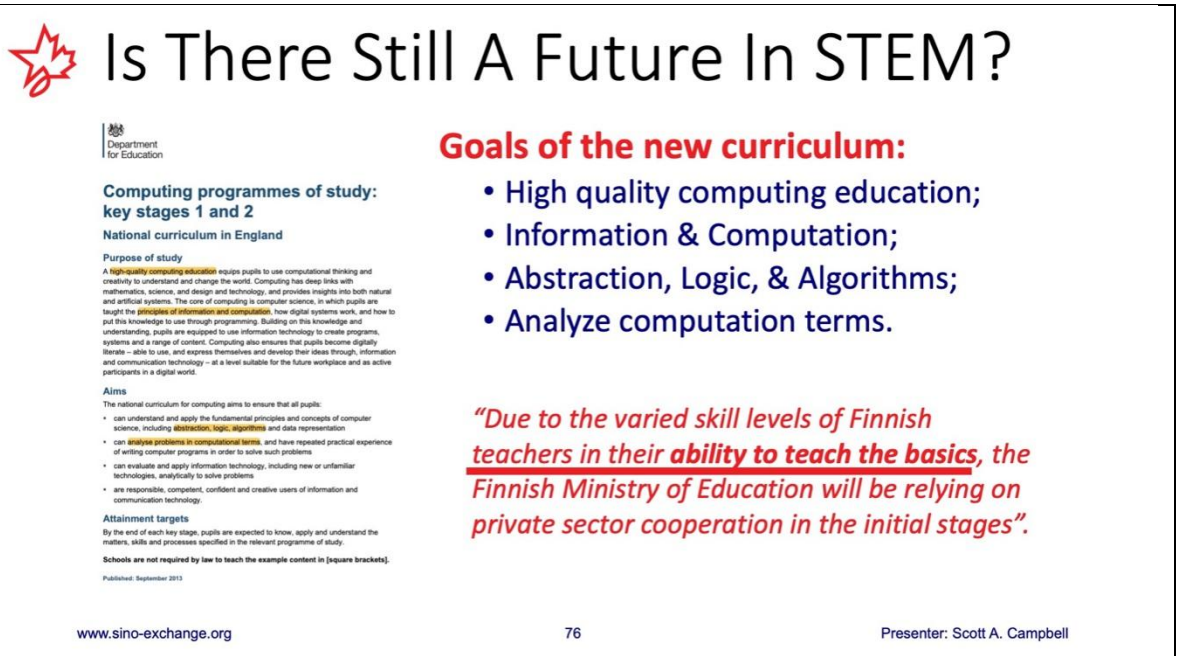
Without a galvanizing force to bring governments, industry, & educators together teachers have essentially been asked to do the impossible, and that's where corporations came to the rescue. Teachers were crying out for support, resources, and materials and companies were all too happy to provide products to fill this need. However, that also gave them an opportunity to start directing the narrative as well. This would give them the power to monopolize on what was unfolding in the educational sector, but I would like to build on this idea a bit more before moving on.	如果没有一股激励力量将政府、行业和教育工作者团结在一起，教师基本上被要求做不可能的事情，而这正是企业出手相救的地方。老师们迫切需要支持、资源和材料，而公司也非常乐意提供产品来满足这一需求。然而，这也给了他们一个开始指导叙事的机会。这将使他们有权垄断教育部门的发展，但在继续前进之前，我想在这个想法的基础上多做一点。
Earlier in the presentation I discussed that different stakeholder groups had different understandings of what STEM education meant to them and that these ideas have diverged over time!	在演讲的早些时候，我讨论了不同的利益相关者群体对 STEM 教育对他们意味着什么有不同的理解，并且随着时间的推移，这些想法已经出现了分歧!
Although it seems unrelated, geopolitics is having a pronounced impact on the global state of STEM education. There used to be more government support to build programs that would help students develop the skills that they needed to support critical sectors in the economy, and this would in-turn help the nation become more	尽管这似乎无关，但地缘政治正在对全球 STEM 教育状况产生明显影响。过去，政府会更多地支持建立项目，帮助学生发展支持经济关键部门所需的技能，这反过来会帮助国家变得更具创新性和竞争力！这将不断推动更多的企业研发。最后，获得了解科学、技术、工程和数

innovative and competitive! Which would continually drive more corporate R&D. And finally, access to a high-quality talent pool that understands the real-world application of Science, Technology, Engineering, & Mathematics makes the entire industry more innovative. Which in-turn strengthens the economy and helps to ensure that the entire country will continue becoming wealthier over time.	学在现实世界中的应用的高质量人才库，使整个行业更加创新。这反过来又加强了经济，有助于确保整个国家随着时间的推移继续变得更加富裕。
And finally, the generation of wealth form private sector that can be taxed benefits the government. However, unlike today we once had found synergy. A system in place where all stake holder groups were united in a common goal, and everybody came out a winner.	最后，可以征税的私营部门财富的产生有利于政府。然而，与今天不同的是，我们曾经发现了协同作用。一个所有利益相关者团体都团结在一个共同目标上的制度，每个人都是赢家。
Unfortunately, times have changed. The wheel of collaboration is broken and as a result, educators have been forced to navigate a very challenging political landscape on top of their role as educators. And this is a result of the turbulent times that we live as most political systems now stand divide on most issues. Therefore, as a result of bipartisan politics, most governments are now too pre-occupied with maintaining a functioning government that they are unable to facilitate the kinds of collaborative endeavors that are needed to build quality STEM programs.	不幸的是，时代已经改变了。合作的车轮被打破了，因此，教育工作者除了扮演教育工作者的角色外，还被迫在一个极具挑战性的政治环境中前行。 这是我们生活的动荡时代的结果，因为大多数政治制度现在在大多数问题上都存在分歧。因此，由于两党政治，大多数政府现在过于忙于维持一个正常运作的政府，无法促进建设高质量 STEM 项目所需的合作努力。
Moreover, cuts to educational spending has become normal in many countries.	此外，削减教育支出在许多国家已成为常态。
So again, we see additional burdens being placed on teachers! To do more, with less, and without much external support!	因此，我们再次看到教师们承受着额外的负担！做更多，用更少，没有太多外部支持！
Therefore, teachers and school administrators are looking at ways to stretch their budgets as far as possible. To build sustainable programs that will maximize the Return on Investment, while extending the useable life cycle of the	因此，教师和学校管理人员正在寻找尽可能扩大预算的方法。建立可持续的项目，最大限度地提高投资回报，同时延长设备的可用寿命。然而，企业正在寻

equipment. However, corporations are looking at ways to maximize their profits which is the exact opposite of trying to lower the total cost of instruction. Therefore, easy to use, highly marketable products that have short life cycles are key to maintaining revenue streams for these companies. Which brings me back to the recommendation of trying to “look beyond the fads”.	找实现利润最大化的方法，这与试图降低教学总成本完全相反。 因此，使用方便、市场占有率高、寿命短的产品是维持这些公司收入流的关键。 这让我回到了尝试“超越时尚”的建议。

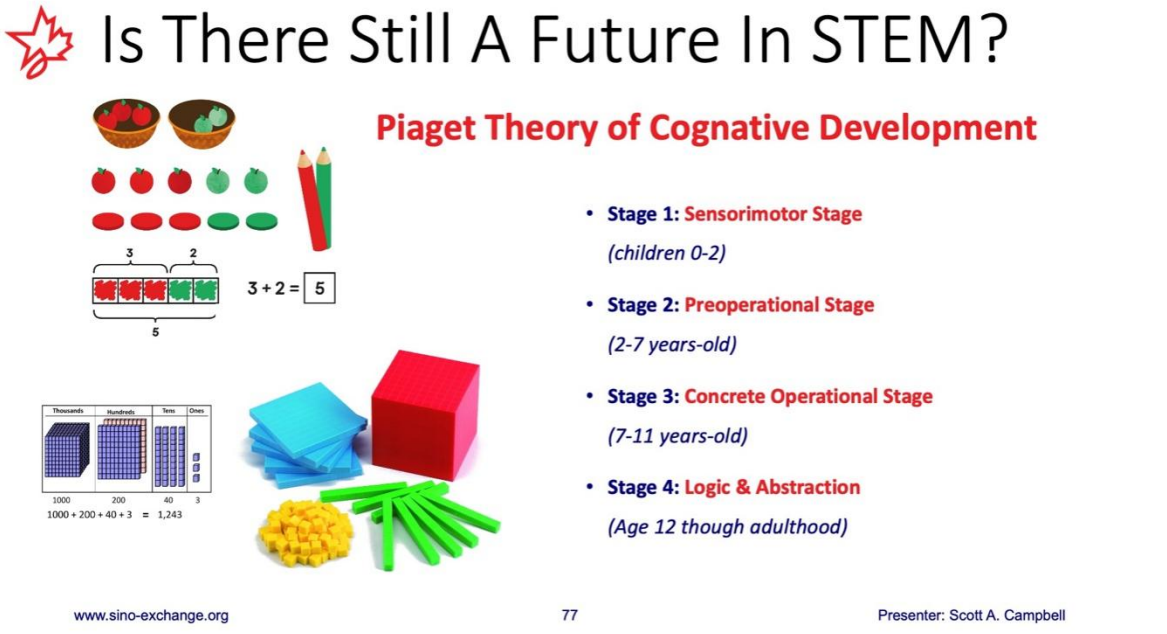
LEGO is a company that has done a great job monopolizing the educational market. And don't get me wrong. Lego is one of my favorite companies, and I highly recommend their products while also issuing a word of caution about blindly jumping on a technology for all the wrong reasons. Which isn't Lego's fault if you do!	乐高是一家在垄断教育市场方面做得很好的公司。 别误会我的意思。乐高是我最喜欢的公司之一，我强烈推荐他们的产品，同时也提醒大家不要因为所有错误的原因而盲目使用一项技术。如果你这样做了，那不是乐高的错!
Now this LEGO DACTA controller was released back in the early 1990's, but you may be surprised to know that the original LEGO robotics kits weren't designed for children. They were designed for engineering students at MIT so they could rapid-prototype ideas in the lab, and the first time I used one of these LEGO DACTA Controllers was at Faculty of Engineering at Queens University. Now fast forward to present day!	现在，这款乐高 DACTA 控制器早在 20 世纪 90 年代初就发布了，但你可能会惊讶地发现，最初的乐高机器人套件并不是为儿童设计的。它们是为麻省理工学院的工程系学生设计的，这样他们就可以在实验室中快速原型化想法。我第一次使用这些乐高 DAFTA 控制器是在皇后大学工程学院。现在快进到今天!
We now have LEGO spike kits being sold to schools in droves to support lower years programing and robotics programs. This product is great because it has a low point of entry in the sense that you can play with it just like a toy, but there is so much potential in what you could do with it as well, and this toy like interface and gamification of programing has become the	我们现在有乐高钉套件成批地出售给学校，以支持低年级的编程和机器人项目。这款产品很棒，因为它的入门点很低，你可以像玩玩具一样玩它，但你也可以用它做很多事情，这种玩具般的界面和编程游戏化已经成为许多 STEM 项目的基石，尤其是随着 STEM 越来越深入年轻一代群体。

corner stone of a lot of STEM programs - especially as STEM pushes further and further into the younger year groups. Now while programming is important, it has begun to dominate the focus of most STEM programs, and this has been at the expense of other sectors that are equally critical to our economy!	现在，尽管编程很重要，但它已经开始成为大多数 STEM 项目的焦点，这是以牺牲对我们经济同样重要的其他部门为代价的!



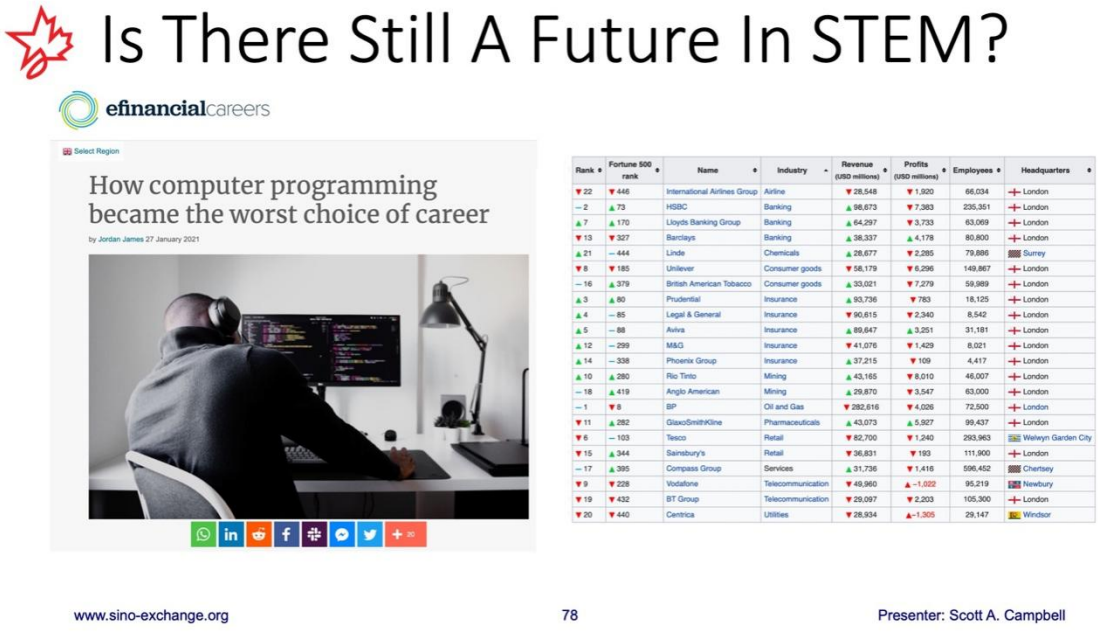
Now because LEGO did such good simplifying coding, while also providing a tactile learning resources the idea that students could learn "Logic" and "Abstraction" from a young age really took hold in international education. For example, England went on to become the first country in the European Union to mandate computer science classes for all children between the ages of 5 and 16. And if you read through their national curriculum, you'll probably be amazed by the learning statements that are indicated in this document. Now for anyone who is unfamiliar with the British system, Key stage 1 & 2 is equivalent to grades 1 and 2 in the US. Now this document goes on to state the following: • High quality computing education. • Information & Computation. • Abstraction, Logic, & Algorithms. • Analyze computation terms. So, we're indicating here that children that are only 5~7 years old should be able to learn concepts such as **Abstraction & Logic, as well as Computational Algorithms**.	现在，由于乐高在简化编码的同时也提供了触觉学习资源，学生从小就可以学习"逻辑"和"抽象"的想法在国际教育中真正深入人心。 例如，英格兰后来成为欧盟第一个强制要求所有 5 至 16 岁儿童参加计算机科学课程的国家。如果你通读他们的国家课程，你可能会对这份文件中的学习陈述感到惊讶。 现在，对于任何不熟悉英国系统的人来说，关键阶段 1 和 2 相当于美国的 1 和 2 年级。现在，本文件继续说明以下内容： • 高质量的计算机教育。 • 信息与计算。 • 抽象、逻辑和算法。 • 分析计算项。 因此，我们在这里指出，只有 5~7 岁的孩子应该能够学习抽象和逻辑以及计算算法等概念。

That's impressive because my first-year university programing course didn't even get all off this. Therefore, there is a real disconnect here.	这让人印象深刻，因为我大学一年级的编程课程甚至都没有完成。因此，这里确实存在脱节。
Another thing that we need to consider is that teachers in primary are not specialists. So, you have this notion of asking a teacher with limited too no experience in programing being asked to teach advanced concepts in programing which is incredibly unrealistic.	我们需要考虑的另一件事是，小学教师不是专家。所以，你有这样的想法，要求一个在编程方面经验有限、太少的老师教授高级编程概念，这是非常不现实的。
Now England is not alone and in 2016 Finland also introduced programming into their national curriculum. However, Finland did identify the following in their initial action plan ***"Due to the varied skill levels of Finnish teachers in their ability to teach the basics, the Finnish Ministry of Education will be relying on private sector cooperation in the initial stages".***	现在，英格兰并不是唯一一个这样的国家，2016 年，芬兰也将编程引入了国家课程。然而，芬兰在其最初的行动计划中确实确定了以下内容："由于芬兰教师在教授基础知识方面的技能水平不同，芬兰教育部将在最初阶段依靠私营部门的合作"。
But this is really concerning! They are concerned with "teachers' ability to teach the basics", and when teachers are asked to teach concepts when they lack the ability to teach the basic it's only logical that students would go on to develop a flawed perceptual paradigm of what they are learning, and this type of ignorance is having a profound impact on industry.	但这确实令人担忧！ 他们关心的是"教师教授基础知识的能力"，当教师被要求在缺乏教授基础知识能力的情况下教授概念时，学生们会继续发展他们所学知识的有缺陷的感知范式，这是合乎逻辑的，而这种无知正对工业产生深远影响。



Now the appropriate age for teaching programing is widely disputed, and I am not likely going to win that argument! But one theory that isn't contested in education Piaget Theory of Cognitive Development.	现在，教授编程的合适年龄受到了广泛的争议，我不太可能赢得这场争论! 但有一种理论在教育中没有争议——皮亚杰认知发展理论。
In Key Stage 1 & 2 we often use a concept called "Physical, Pictural, Abstract" which is sometimes also referred to as "Concrete, Pictural, Abstract", and I have an example here to illustrate the concept if you are unfamiliar with it.	在关键阶段 1 和 2 中，我们经常使用一个名为"物理、图片、抽象"的概念，有时也被称为"具体、图片、摘要"，如果你不熟悉，我在这里举一个例子来说明这个概念。
At this age students are still developing their perceptional understanding of the world around them. They may be very creative and imaginative, but imagination is not the same as abstract thought, but the key thing is that students at this stage are developing some level of abstraction as they move from physical to abstract representations in things like number systems. However, this is very different than what abstraction means computer science & programing.	在这个年龄段，学生们仍在发展他们对周围世界的感知理解。他们可能非常有创造力和想象力，但想象力与抽象思维不同，但关键是，这个阶段的学生在数字系统等事物中从物理表征转向抽象表征时，正在发展某种程度的抽象。然而，这与抽象意味着计算机科学和编程有很大不同。
Moreover, in grades 2 through 5 students are still using the tactile math blocks that	此外，在 2 到 5 年级的学生仍然在使用你在这里看到的触觉数学块。这些是几十个、几百个和几千个街区。

you see here. These are the ones, tens, hundreds, and thousands blocks. While smaller values are used at the lower grade levels. The math example that I've provide here is more typical of a grade 5 curriculum. But as you can see students still wouldn't have learnt concepts such as order of operations, algebra, Boolean operations, and logic which are all key precursors to learning computer science if we are going to look at concepts such as Abstraction, Logic, and Computational Algorithms in an authentic way which wouldn't start happening until the child becomes a teenager Therefore, the only way that we can push such advanced concepts into such a young age group is too continual simplify and gamify a complex idea to the point of completely misrepresenting the true nature of that concept in the first place.	而较小的值用于较低级别。 我在这里提供的数学示例更典型的是五年级的课程。 但正如你所看到的，如果我们要以一种真实的方式看待抽象、逻辑和计算算法等概念，而这些概念直到孩子十几岁才开始发生，那么学生们仍然不会学习运算顺序、代数、布尔运算和逻辑等概念，这些都是学习计算机科学的关键前兆。因此，我们能把如此先进的概念推向如此年轻的群体的唯一方法是过于持续地简化和游戏化一个复杂的想法，以至于一开始就完全歪曲了这个概念的真实本质。



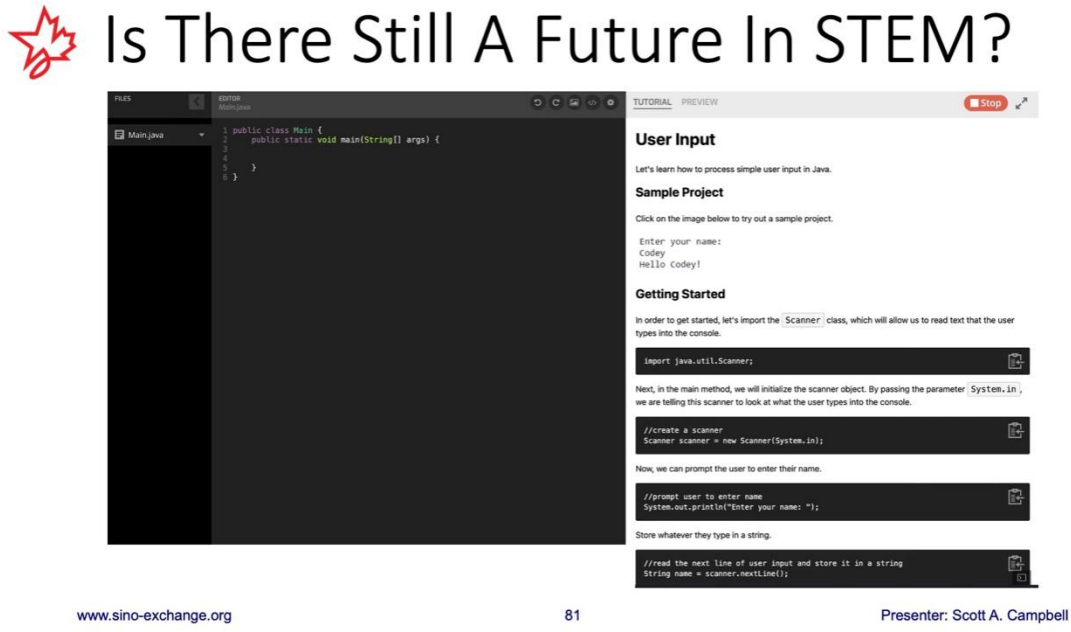
Rank	Fortune 500 rank	Name	Industry	Revenue (USD millions)	Profits (USD millions)	Employees	Headquarters
▼22	▼446	International Airlines Group	Airline	▼28,548	▼1,920	66,034	London
— 2	▲73	HSBC	Banking	▲98,673	▼7,383	235,351	London
▲7	▲170	Lloyds Banking Group	Banking	▲64,297	▼3,733	63,069	London
▼13	▼327	Barclays	Banking	▲38,337	▲4,178	80,800	London
▲21	— 444	Linde	Chemicals	▲28,677	▼2,285	79,886	Surrey
▼8	▼185	Unilever	Consumer goods	▼58,179	▼6,296	149,867	London
— 16	▲379	British American Tobacco	Consumer goods	▲33,021	▼7,279	59,989	London
▲3	▲80	Prudential	Insurance	▲93,736	▼783	18,125	London
▲4	— 85	Legal & General	Insurance	▼90,615	▼2,340	8,542	London
▲5	— 88	Aviva	Insurance	▲89,647	▲3,251	31,181	London
▲12	— 299	M&G	Insurance	▼41,076	▼1,429	8,021	London
▲14	— 338	Phoenix Group	Insurance	▲37,215	▼109	4,417	London
▲10	▲280	Rio Tinto	Mining	▲43,165	▼8,010	46,007	London
— 18	▲419	Anglo American	Mining	▲29,870	▼3,547	63,000	London
— 1	▼8	BP	Oil and Gas	▼282,616	▼4,026	72,500	London
▼11	▲282	GlaxoSmithKline	Pharmaceuticals	▲43,073	▲5,927	99,437	London
▼6	— 103	Tesco	Retail	▼82,700	▼1,240	293,963	Welwyn Garden City
▼15	▲344	Sainsbury's	Retail	▼36,831	▼193	111,900	London
— 17	▲395	Compass Group	Services	▲31,736	▼1,416	596,452	Chertsey
▼9	▼228	Vodafone	Telecommunication	▼49,960	▲–1,022	95,219	Newbury
▼19	▼432	BT Group	Telecommunication	▼29,097	▼2,203	105,300	London
▼20	▼440	Centrica	Utilities	▼28,934	▲–1,305	29,147	Windsor

Now to illustrate the naivety of this decision I turn to this UK article that was published by “efinancial careers”. ***“How computer programing became the worst choice of career”***, but if one news article is not enough to illustrate a possible disconnect with our perceptions vs reality in education, let’s look at a key economic indicator! Here is a list of all the fortune 500 companies in England. Now despite being the first country to introduce a national curriculum that required students to learn computer science and programing, we do not see a single company in Artificial Intelligence, Hardware or Computer Engineering, or Software development.	现在，为了说明这个决定的天真，我转向这篇由“定义职业”发表的英国文章。“计算机编程是如何成为最糟糕的职业选择的”，但如果一篇新闻文章不足以说明我们在教育中的认知与现实可能存在脱节，那么让我们看看一个关键的经济指标吧！ 以下是英国所有财富 500 强公司的名单。现在，尽管我们是第一个引入要求学生学习计算机科学和编程的国家课程的国家，但我们在人工智能、硬件或计算机工程或软件开发领域看不到一家公司。

And when we look at critical skill shortages in the UK, we see that Electrical, Computer, and Software engineering are at top of the list, and there are also many other sectors listed as well, which I talked about earlier when discussing the different types of careers in STEM at the beginning of my presentation.	当我们审视英国的关键技能短缺时，我们会发现电气、计算机和软件工程位居榜首，还有许多其他行业也在列，我在演讲开始时讨论 STEM 的不同职业类型时谈到过。

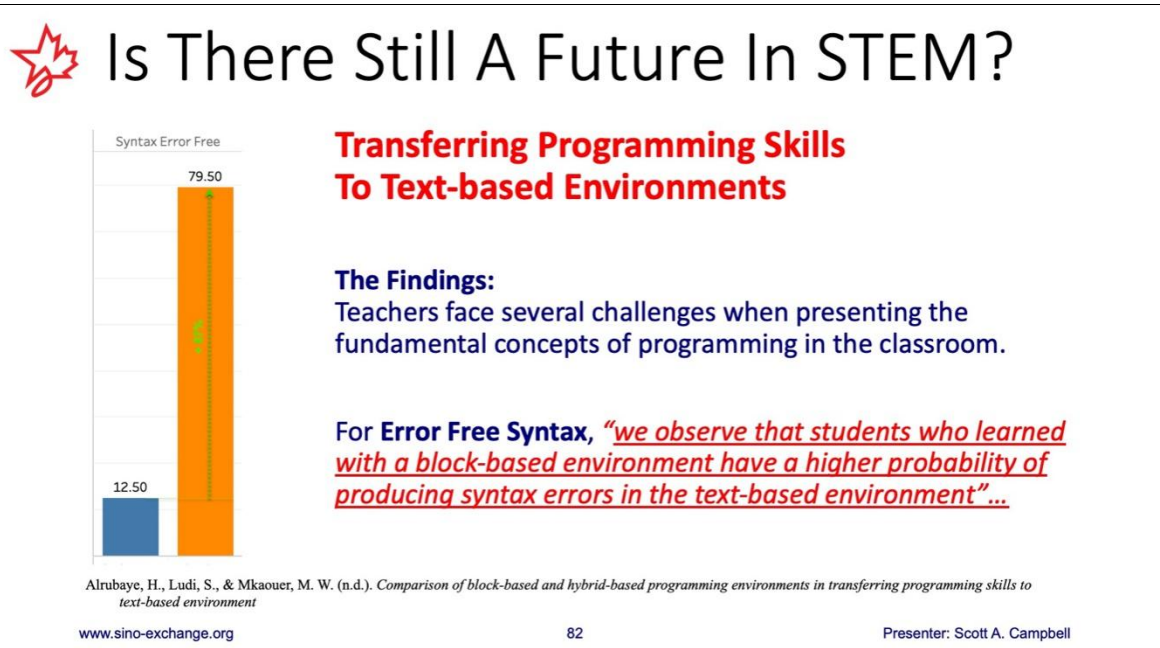
So, Let's look at how these critical skill shortages affect the economy.	因此，让我们来看看这些严重的技能短缺是如何影响经济的。
This report shows, the UK has serious skill shortages in sectors that are critical to the economy such as engineering, and this has made the UK dependant on foreign expertise and technologies. Specifically in telecommunications infrastructure and network engineering, and due to the current geopolitical situation, many MPs perceive that there is an imamate threat to England's national security. Whether or not such a threat really exists is another issue completely, but there is enough of a perception to urge the government to end all contracts with leading telecom giant Huawei.	这份报告显示，英国在工程等对经济至关重要的行业存在严重的技能短缺，这使得英国依赖外国专业知识和技术。特别是在电信基础设施和网络工程方面，由于当前的地缘政治局势，许多议员认为英格兰的国家安全面临着巨大威胁。这种威胁是否真的存在完全是另一个问题，但有足够的看法敦促政府终止与领先电信巨头华为的所有合同。
But what does this decision mean for British customers?	但这一决定对英国客户意味着什么？
Well, they will be left paying for a multi-million-dollar network overhaul, that will see the delay of 5G services nation-wide. In layman's terms, they will pay more money to have inferior services for several years while they catch up to the rest of the world, and this will an adverse effect on businesses as they will have to compete	好吧，他们将为数百万美元的网络大修买单，这将导致全国 5G 服务的延迟。用外行的话来说，他们将在几年内支付更多的钱来获得劣质服务，同时赶上世界其他地区，这将对企业产生不利影响，因为他们将不得不使用更旧、更慢的网络技术进行竞争，同时首先要支付更多

using older and slower network technologies, while paying more money to access to these services in the first place. Therefore, the failure to meet the needs of these critical sectors does have a direct effect on the economy, security, and national sovereignty as well.	的资金来获得这些服务。因此，未能满足这些关键部门的需求确实对经济、安全和国家主权产生了直接影响。

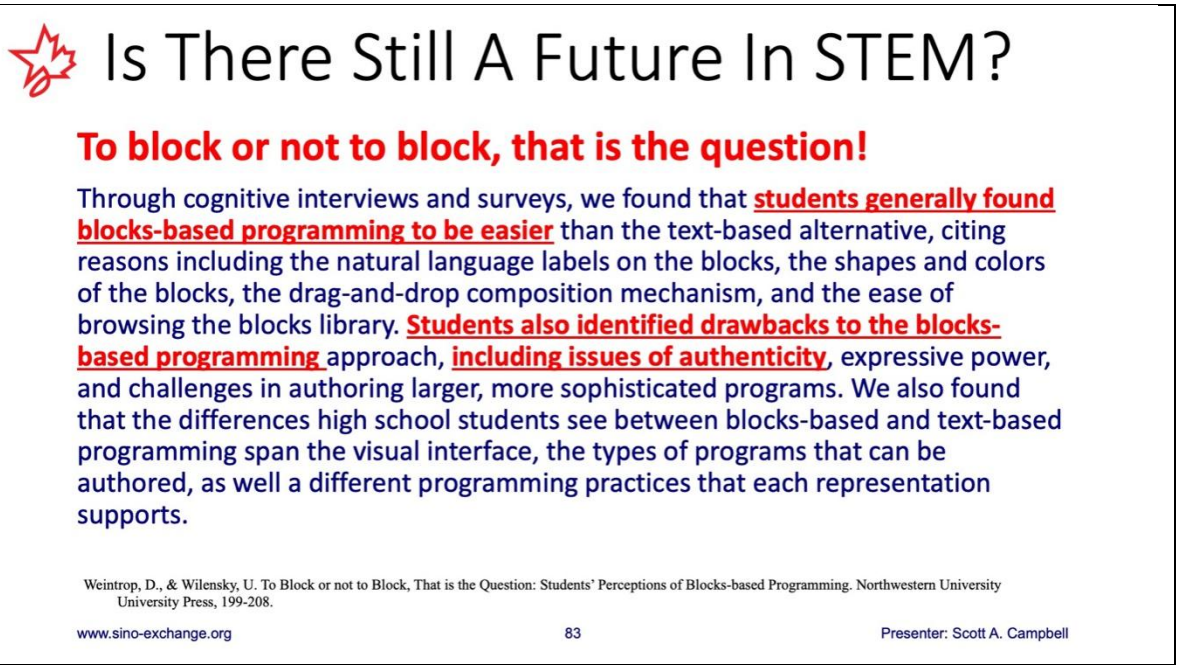


So how is it that a country that has invested so much time, money, and resources into developing a nation computer science curriculum be lagging so far behind other countries that don't even offer computing course in the curriculum?	那么，一个在开发国家计算机科学课程方面投入了如此多时间、金钱和资源的国家，怎么会远远落后于其他甚至不在课程中提供计算机课程的国家呢？
Well remember that story I told you at the very beginning of my presentation. The one where fortune 500 companies did not want to heir graduates with relevant degrees because they often had developed a flawed operational paradigm! Well, that's what we're seeing here. In order to teach programing to all students regardless of their aptitude or interest in programing companies needed to resort to simplification and the gamification of programing skills which has resulted in the true nature of programing being misrepresented to an entire generation of students!	还记得我在演讲一开始就告诉你的那个故事吗。财富 500 强公司不想继承拥有相关学位的毕业生，因为他们经常开发出有缺陷的运营模式！这就是我们在这里看到的。为了向所有学生教授编程，无论他们的资质或对编程的兴趣如何，编程公司需要求助于编程技能的简化和游戏化，这导致编程的真实本质被整整一代学生歪曲了！
So I want to return to this quote from the Finish Ministry of education: ***"Due to the varied skill levels of Finnish teachers in their ability to teach the basics".*** The government knows that their teachers do not have the skills needed to teach programing properly! Therefore, they are	因此，我想回到芬兰教育部的这句话：“由于芬兰教师在教授基础知识方面的技能水平不同”。政府知道他们的老师不具备正确教授编程所需的技能！因此，他们将依靠公司来创造现成的解决方案，让普通教师能够在不需要事先学习或经验的情况下教授编程。

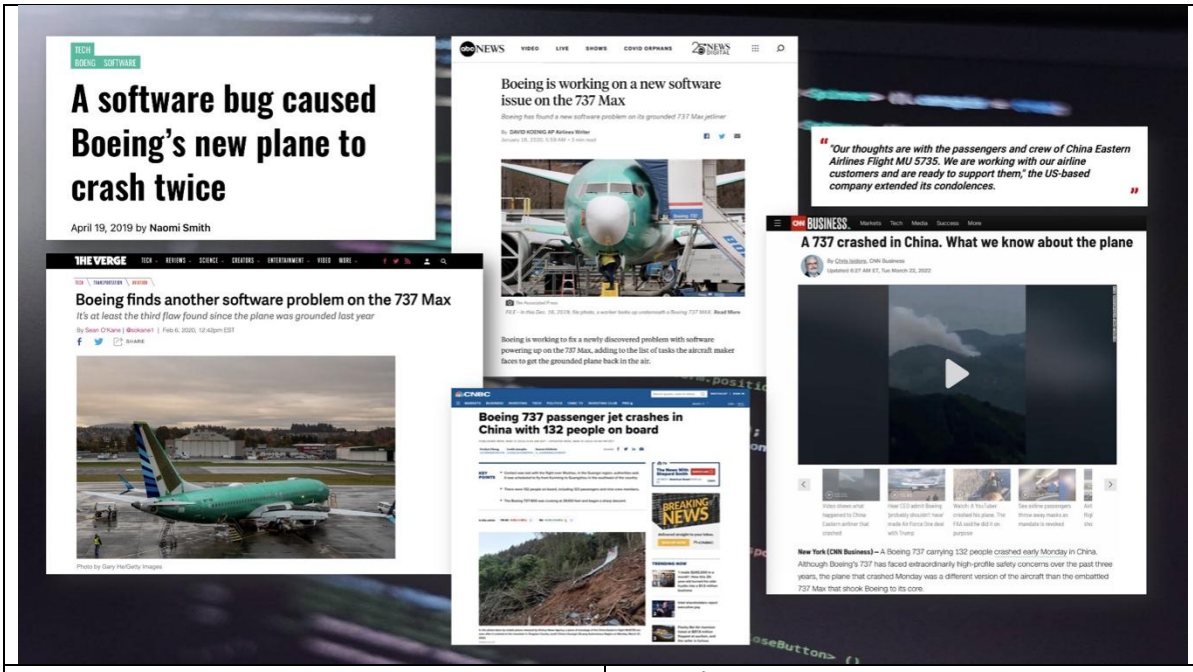
going to rely on corporations to create ready-made solutions that would allow the average teacher to be able to teach programing with no prior learning or experience being necessary.	
So let me show you what one of these solutions look like in practice. This is a video that I was given by an experienced computer science teacher. As you can see, they just click on the insert button and the code just magically populated the relevant areas. Now to a teacher or administrator who knows nothing about programing it would be easy to walk into this class and be impressed by what's happening. But in all honesty, all we've done is to completely misrepresent the true nature of programing! And that would encourage the wrong students to purse programing for all the wrong reasons. In reality, what we've done has created a flawed perceptual paradigm of what programming is and that could be detrimental to the student's future success in the fields of computer science.	因此，让我向您展示这些解决方案中的一个在实践中是什么样子的。这是一个经验丰富的计算机科学老师给我的视频。正如您所看到的，他们只需点击插入按钮，代码就神奇地填充了相关区域。现在，对于一个对编程一无所知的老师或管理员来说，走进这门课并对所发生的事情印象深刻是很容易的。但老实说，我们所做的只是完全歪曲编程的真实本质！这会鼓励错误的学生出于所有错误的原因来资助课程。事实上，我们所做的创造了一种有缺陷的编程感知范式，这可能不利于学生未来在计算机科学领域的成功。
But let me further support that notion with some evidenced based research.	但让我通过一些基于证据的研究来进一步支持这一观点。



So here is a key take away from a research study from the Rochester Institute of Technology. They indicated that ***"Teachers face several challenges when presenting the fundamental concepts of programming in the classroom".*** The research study also found that: "**students who learnt programing using a block-based environment had a higher probability of producing syntax errors in authentic text-based programing environment"**, and as you can see by this chart, the discrepancy is staggering.	因此，以下是罗切斯特理工学院的一项研究的关键结论。他们指出，"教师在课堂上展示编程的基本概念时面临着一些挑战"。研究还发现："使用基于块的环境学习编程的学生在真实的基于文本的编程环境中产生语法错误的概率更高"，正如你从这张图表中看到的，这种差异是惊人的。

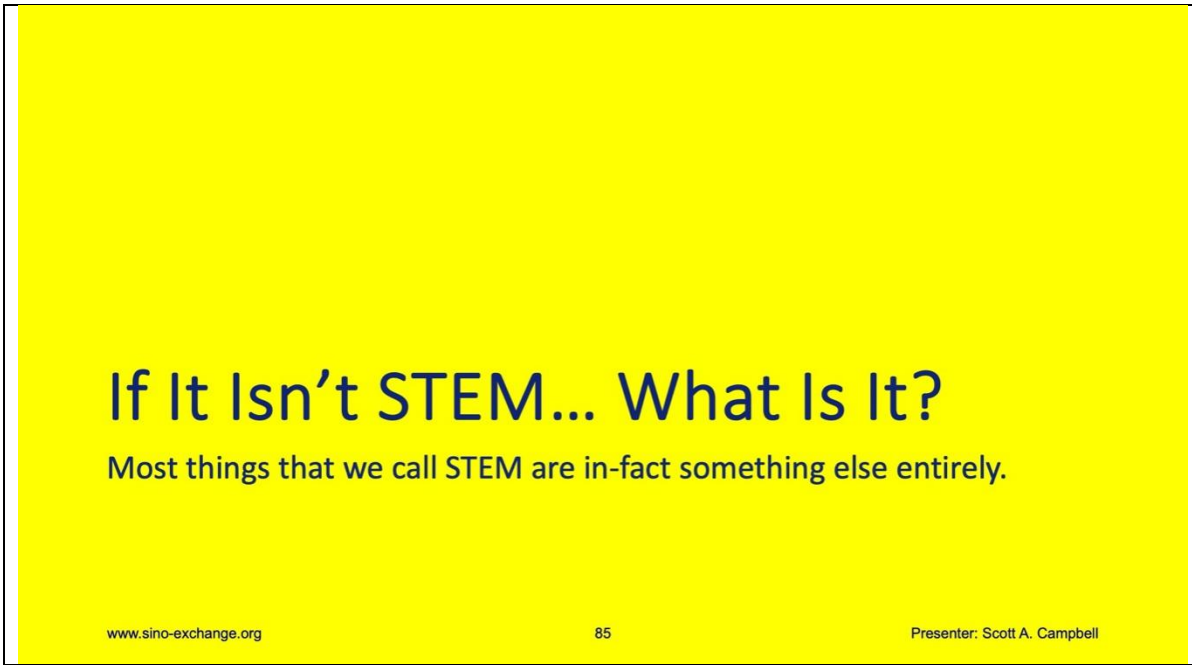


Another study form Northwestern University had similar findings. They indicated that "**students generally found blocks-based programming to be easier**" but the students went on to identify issues of authenticity. Now when we think about the original mandates of STEM education which were to create "rigorous academic programs to compete in the new economy" the very notion of our instruction methods lacking authentic seams questionable.	西北大学的另一项研究也有类似的发现。他们指出，"学生们普遍认为基于块的编程更容易" 但学生们继续发现了真实性的问题。现在，当我们想到 STEM 教育的最初任务是创建"在新经济中竞争的严格学术项目"时，我们的教学方法缺乏真实接缝的概念本身就值得怀疑。



Now please do not get me wrong. Programing is incredibly important. But it's also an incredibly difficult subject area to teach well. What I am implying here is that programming needs to be done by a professional who knows what they are talking about, and it needs to be done at point in time where students have the cognitive ability to properly engage with abstract concepts, logic, and computation. Furthermore, we also need to make sure that we are not misrepresenting the true nature of programing either. For instance, the gamification and simplification of programing has created a seriously flawed perception of what programing is all about.	现在请不要误解我的意思。编程非常重要。但这也是一个非常难教好的学科领域。我在这里的意思是，编程需要由知道他们在说什么的专业人员来完成，并且需要在学生有认知能力正确参与抽象概念、逻辑和计算的时候完成。 此外，我们还需要确保我们也没有歪曲编程的真实性质。例如，编程的游戏化和简化造成了对编程本质的严重缺陷。
So, what happens when students don't take programming seriously, and their programs are riddled with syntax errors as we saw in those research studies?	那么，当学生们不认真对待编程，他们的程序中充斥着语法错误时，会发生什么呢？
What happens when there are Syntax errors in our traffic lights control systems, the national PowerGrid, or in a life support system?	当我们的红绿灯控制系统、国家电网或生命支持系统出现语法错误时，会发生什么？
Or what about these examples of a software glitches in the Boeing 737 which	或者，这些波音 737 飞机软件故障的例子呢？在不到一年的时间里，波音 737

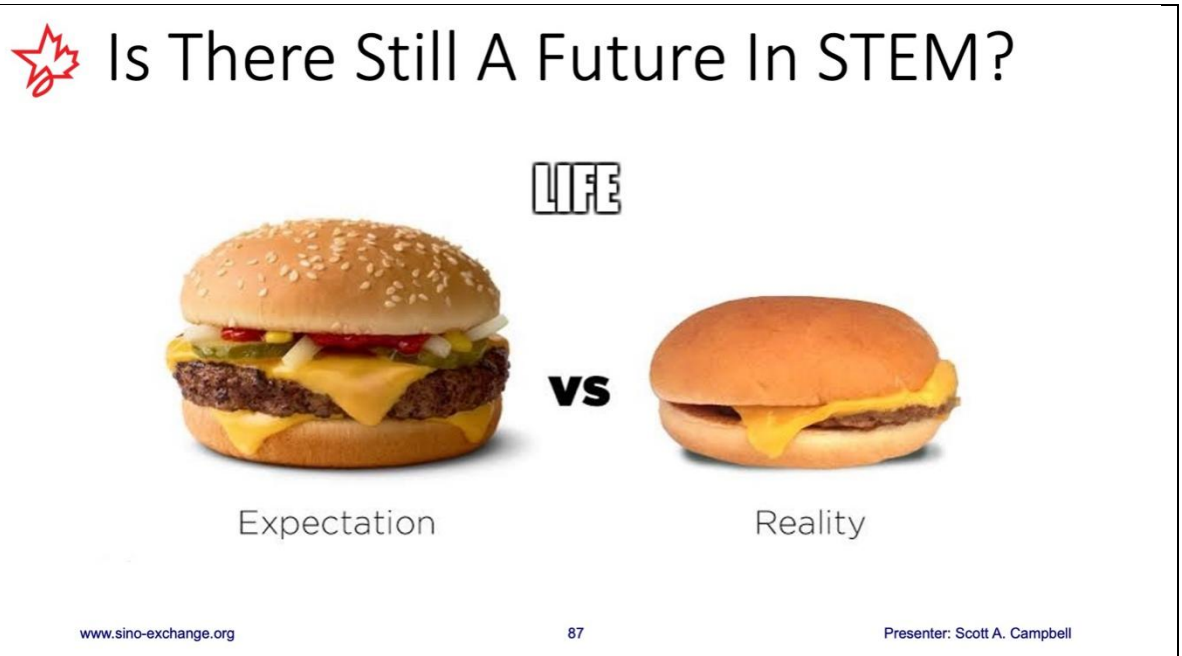
resulted in 2 plane crashes in less than a year **killing all passengers on-board!** I can go on and cite numerous examples from around the world where hundreds of people have died as a result of faulty programing which really illustrates the point that I am trying to make. There is nothing wrong with teaching programing, but it's important that programing is taught by qualified professional, and at a point where the learner has developed necessary cognitive thought processes that are needed to be able to interact with content in a meaningful way!	飞机发生了两起坠机事故，机上所有乘客全部遇难！ 我可以继续列举来自世界各地的许多例子，其中数百人因错误的编程而死亡，这确实说明了我试图表达的观点。编程教学没有错，但重要的是，编程应由合格的专业人员教授，并且在学习者已经发展出必要的认知思维过程的时候，才能以有意义的方式与内容互动！



If it isn't STEM…. Then what is it?	如果不是 STEM 那是什么?

Let's look at these 3 projects for a moment. The first one is a science diorama. Is it cross-curricular? Dose it solve any real-world problems, and more importantly does it promote innovation? While this projected is some-what cross curricular nature, the art is peripheral to developing our understanding of the solar system. Furthermore, this project does not address a legitimate need but a desire to make a fun and engaging project!	让我们看一下这 3 个项目。 第一个是科学立体模型。 它是跨课程的吗？它能解决现实世界中的任何问题吗？更重要的是，它能促进创新吗？虽然这是一些跨学科的性质，但艺术对发展我们对太阳系的理解是次要的。 此外，这个项目并不是为了满足合法的需求，而是为了制作一个有趣且引人入胜的项目！
Great! That's a perfectly valid outcome; however, it's not STEM by definition. This is a prime example of **Project Based Learning** which is an excellent approach to teaching and learning that any teacher could incorporate into their classroom regardless of the subject area that they teach.	太棒了 这是一个完全有效的结果；然而，它并不是 STEM 的定义。这是基于项目的学习的一个典型例子，这是一种优秀的教学方法，任何教师都可以将其融入课堂，无论他们教授的科目是什么。
Next is LEGO which I personally love, while also being somewhat critical of its overuse in schools. Now if we consider Piaget's Theory of cognitive development this kind of kinesthetic activity excellent for the development of Concrete Operational skills between the ages 7 to 11 years old. Again, this isn't STEM! This represent **Play'n'learn**	接下来是我个人喜欢的乐高，同时也对它在学校的过度使用持批评态度。现在，如果我们考虑皮亚杰的认知发展理论，这种动觉活动对 7 至 11 岁之间的具体操作技能的发展非常有利。再说一遍，这不是 STEM！这代表了游戏学习，也是一个非常有效的框架，对这个年龄段的儿童的认知发展至关重要。

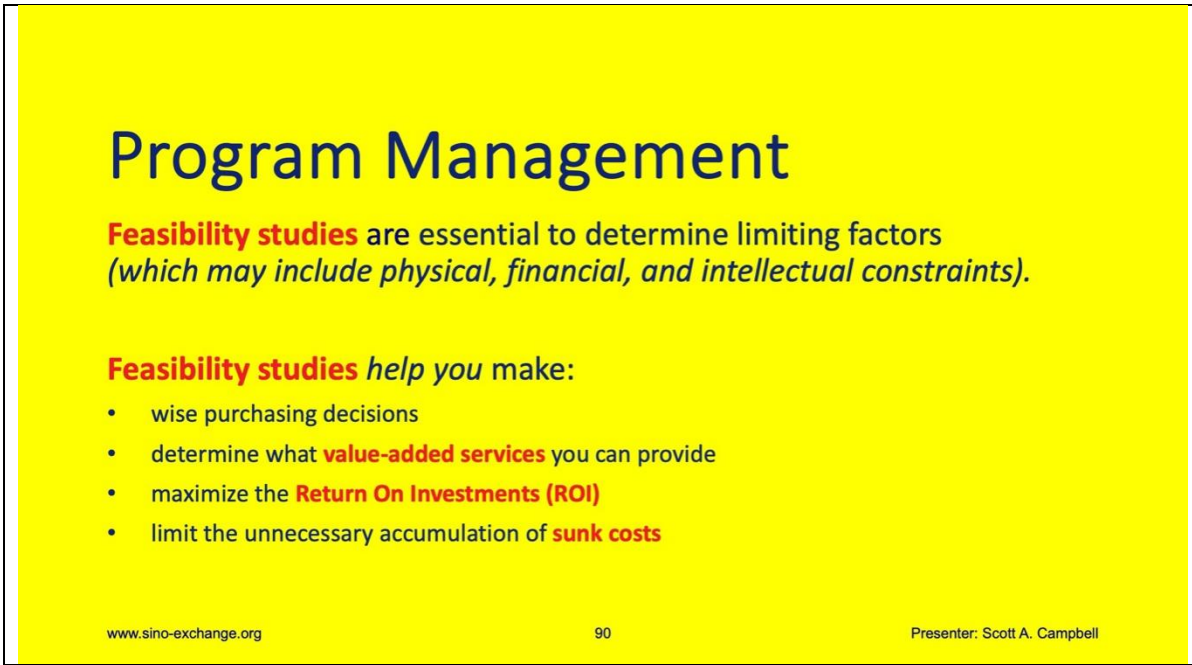
which is also a perfectly valid framework and it's critical for the cognitive development in children at this age. And finally, the robot! Of course, we all think that this is STEM because the student made a robot! But did they really make a robot? They could have made anything here, a fairy princess, a superhero, or an animal friend. This is just arts and crafts. This is what's happening now that schools try to make K-12 STEM programs without really understanding the true nature of STEM education. Perfectly valid teaching pedagogies being swallowed up by the STEM CRAZE! But this kind off flawed misrepresentation of STEM only contributes to us moving further and further away from our original objectives which was to create **rigorous academic programs** that promoted the **real-world applications of science, technology, engineering and math** skills which would **prepare students for the new economy**.	最后，机器人！当然，我们都认为这是 STEM，因为这个学生做了一个机器人！但是他们真的造了一个机器人吗？他们可以在这里做任何事情，一个童话公主，一个超级英雄，或者一个动物朋友。这只是工艺美术。 这就是现在发生的事情，学校试图在没有真正了解 STEM 教育的真实性质的情况下制定 K-12 STEM 课程。完美有效的教学方法被 STEM 疯狂吞噬！但是，这种对 STEM 的错误陈述只会让我们越来越偏离我们最初的目标，即创建严格的学术项目，促进科学、技术、工程和数学技能在现实世界中的应用，让学生为新经济做好准备。



And that brings me back to my example about coffee at the start of this presentation, people's perceptions are often very different from reality.	这让我回到了我在演讲开始时关于咖啡的例子，人们的看法往往与现实大相径庭。
Now I am sure everyone is aware of these kinds of "MEMES" related expectations vs reality.	现在，我相信每个人都意识到了这些与"MEMES"相关的期望与现实。
So again, I am going to come back to the notion that STEM was created in response to national studies that were indicated that America was falling behind other nations in critical sectors to the economy. While the VTE programs of the 70's~90's benefited from the collaboration between governments, industry leaders, and educators alike the STEM movement of the 21st century didn't have a galvanizing catalyst to drive educational reforms. So now, more than 20 years later with the evolution of STEM into STEAM and the widespread adoption of these programs in most schools what do the numbers really look like?	因此，我将再次回到 STEM 的创建是为了回应国家研究的观点，这些研究表明，美国在经济的关键部门落后于其他国家。虽然 70 年代至 90 年代的 VTE 项目受益于政府、行业领袖和教育工作者之间的合作，但 21 世纪的 STEM 运动并没有推动教育改革的激励催化剂。那么，20 多年后的今天，随着 STEM 向 STEAM 的演变，以及这些项目在大多数学校的广泛采用，这些数字到底是什么样子的呢?

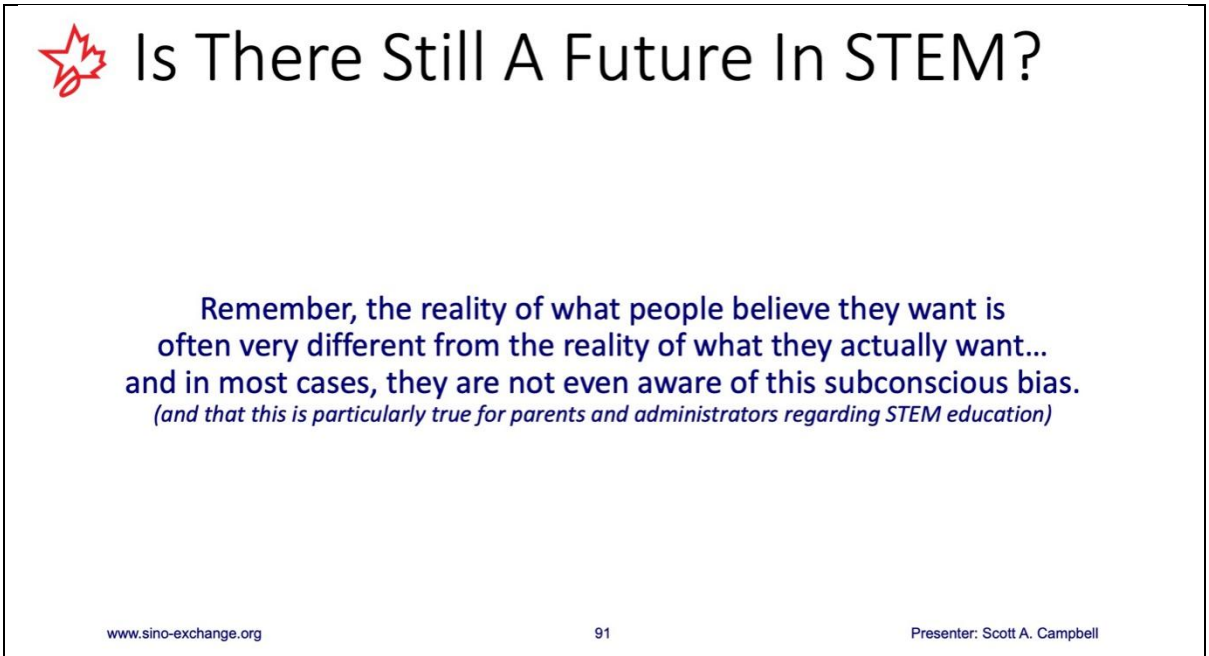
Unfortunately, things didn't turn out the way that we wanted! We have missed our mark!	不幸的是，事情并没有按照我们想要的方式发展！我们没有达到目标！
Look at America!	看看美国！
The nation that was once the world leader. The country that invented STEM education to advance scientific and mathematical literacies, and yet they are still falling even further behind in these key educational metrics. And why is that?	曾经是世界领袖的国家。这个国家发明了 STEM 教育来提高科学和数学素养，但在这些关键的教育指标上，他们仍然落后。为什么？
Because teachers were never properly supported in the early days of STEM education, and this led to confusion and disarray with the development of STEM programs worldwide! The data speaks for itself, and we can see the long-term results clearly if we take the time to look.	因为在 STEM 教育的早期，教师从未得到适当的支持，这导致了世界范围内 STEM 项目的发展混乱和混乱！数据不言自明，如果我们花时间去看，我们可以清楚地看到长期结果。
But what about Canada? They're at the top of the list for English-speaking countries! So, what are they doing that is different than other English-speaking nations?	但是加拿大呢？他们在英语国家排行榜上名列前茅！那么，他们的做法与其他英语国家有什么不同呢？

Well Canada is one of the few nations that has a **Vocational Teacher Education Program** which allows industry professionals to become qualified teachers. But not only is the program track available, it's actually a requirement for teachers that want to teach any of the high-skilled technologies such as Electrical, Computer, and Mechanical Engineering. Therefore, these rigorous academic programs are being taught by highly trained professionals, and these professionals have invaluable experiences that they can bring to education that help them design authentic "real-world lessons" that apply science, technology, engineering, and mathematics in appropriate context, and this will prepare students for the new global economy, and we can see those key words that we keep talking about from the original mission statement for STEM education popping up again and again.	加拿大是少数几个拥有职业教师教育计划的国家之一，该计划允许行业专业人员成为合格的教师。但这不仅是课程轨道，而且实际上是对想要教授电气、计算机和机械工程等任何高技能技术的教师的要求。因此，这些严格的学术课程由训练有素的专业人员教授，这些专业人员可以将宝贵的经验带到教育中，帮助他们设计真实的"现实世界课程"，将科学、技术、工程和数学应用于适当的环境中。这将使学生为新的全球经济做好准备，我们可以看到我们在 STEM 教育最初的使命宣言中不断谈论的关键词一次又一次地出现。



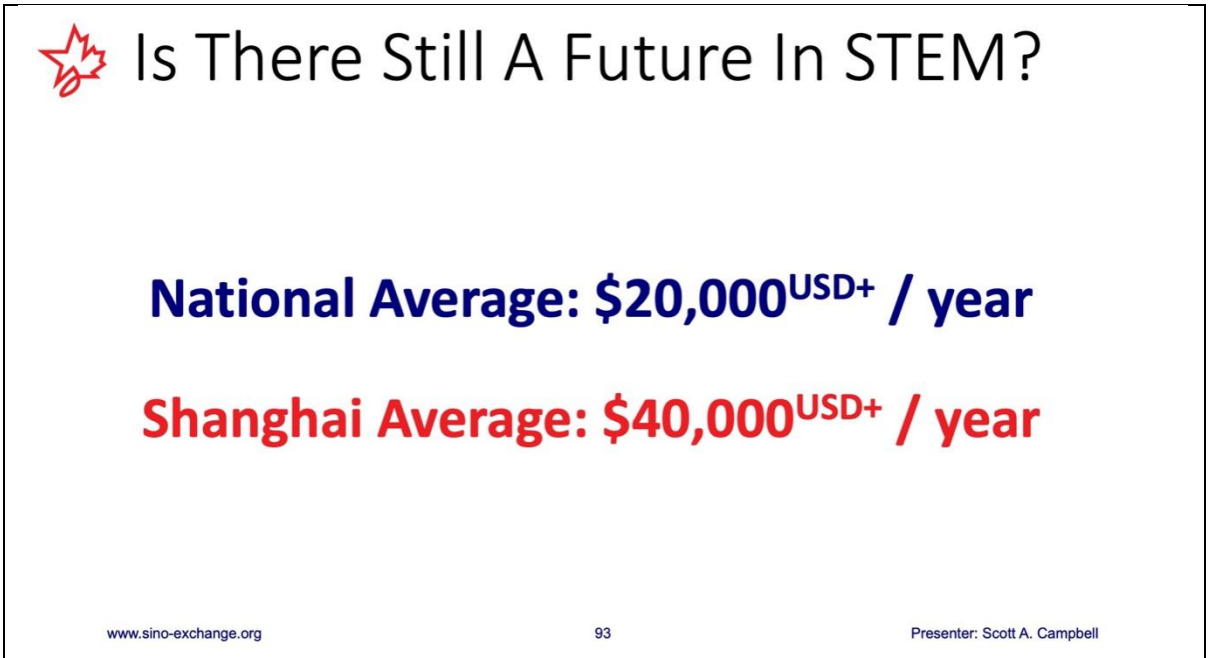
So far, I have talked a lot about ideas that would be germane to educators. However, I haven't spent. Much time to address program management which is something that most school administrators are probably interested in learning more about. Now the key thing I can recommend here is that you take the time to question your own decisions. To be critical thinkers and delve deeper into your own decision-making process. To consistently evaluate the integrity of your own decision-making process!	到目前为止，我已经谈论了很多与教育工作者密切相关的想法。然而，我没有花。花了很多时间来讨论项目管理问题，这可能是大多数学校管理人员感兴趣了解更多的东西。现在，我可以在这里建议的关键是，你要花时间质疑自己的决定。成为批判性的思考者，深入研究自己的决策过程。始终如一地评估自己决策过程的完整性！
Now this doesn't mean that you should second guess every decision or that the decisions that you've been making are wrong. What that means is that you need to make sure that are not making decisions based on pre-conceptions that maintain the business-as-usual mindset. Instead, you need to push yourself to make rational decisions that are based on fact, and this is very difficult for us to as we're not wired this way! We're species that's governed by our emotions and not logic, and as we've seen so far, even the CEOs of some of the world's largest companies still struggle to overcome this challenge. Therefore, leaders need to take a moment for themselves. To	这并不意味着你应该对每一个决定都进行事后猜测，也不意味着你所做的决定都是错误的。这意味着你需要确保你的决策不是基于维持一切照旧心态的预先概念。相反，你需要强迫自己根据事实做出理性的决定，这对我们来说非常困难，因为我们不是这样的！我们是受情绪而非逻辑支配的物种，正如我们迄今为止所看到的，即使是世界上一些最大公司的首席执行官也仍在努力克服这一挑战。因此，领导者需要为自己留一点时间。退后一步，批判性地反思自己的想法，并确保他们的行动与学校的愿景和使命宣言相一致，这是世界上最好的商学院教授 MBA 毕业生的核心理念。然

step back and critically reflect upon their own ideas, and to make sure that their actions align with their school's vision, and mission statements which is an idea that is at the heart of what the best business schools in the world teach their MBA graduates. However, there is no right or wrong answer here. Only a mindset of critically evaluating the very essence of the decisions that you make. To ensure that your actions uphold your ideals, vision, and corporate mission statement.	而，这里没有正确或错误的答案。只有一种批判性地评估你所做决定的本质的心态。确保您的行动坚持您的理想、愿景和企业使命宣言。

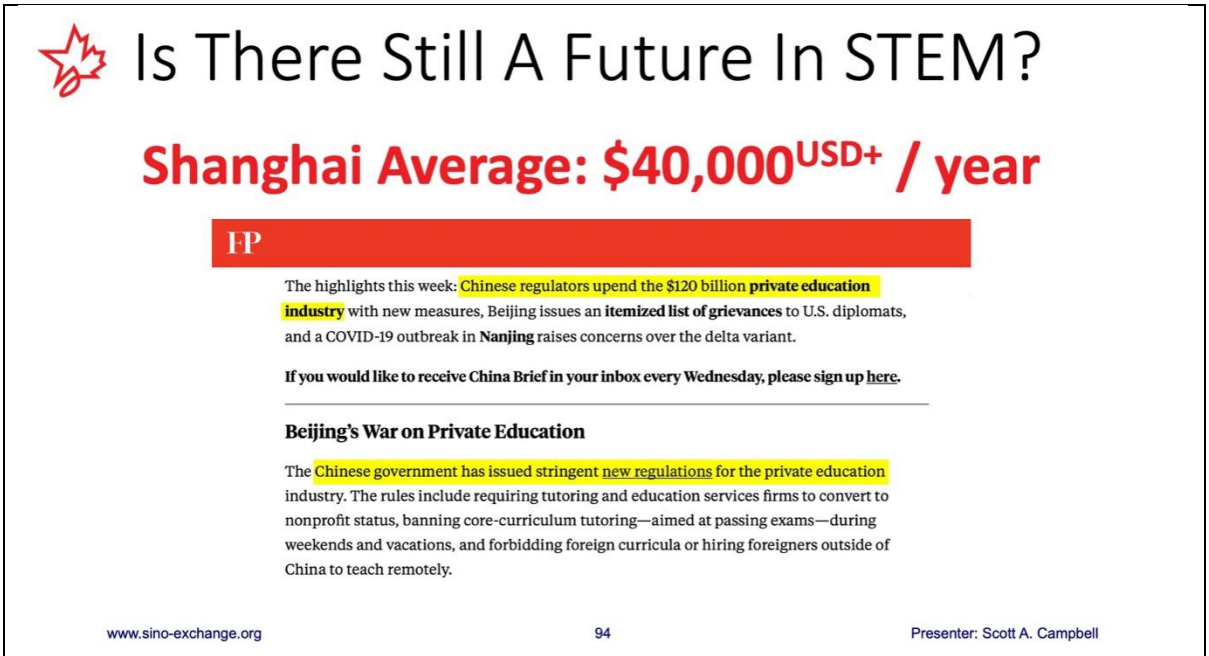


Now remember when I introduced the idea that most people's perceptions of what they think they want compared to what they actually want being two very dissociated concepts. Well, this concept this is particularly true for parents and administrators in regard to STEM education!	现在请记住，当我介绍这样一个观点时，大多数人对他们认为自己想要的东西的看法与他们实际想要的东西相比，是两个非常分离的概念。好吧，这个概念对 STEM 教育的家长和管理者来说尤其正确！

Let me illustrate this point.	让我来说明这一点。
Here in China parents want the best for their child. They want holistic education, and they don't want their child to go through the mass hysteria of an exam-based system such as the Chinese Gaokao. But what's the first thing that these parents do after pulling their child out of a rigorous exam-based system? They typically enroll their child in either iGCSE courses, which is just another exam-based system, or they get their child to take as many AP course as possible. Which again is an exam-based system. This example really illustrates how parent's perceptions of what they want. However, the reality of what they want for their children is a completely different thing.	在中国，父母希望孩子得到最好的。他们想要全面的教育，他们不希望自己的孩子经历像中国高考这样以考试为基础的集体歇斯底里。但是，这些父母在把孩子从严格的考试制度中拉出来后，第一件事是什么？他们通常会让孩子参加 iGCSE 课程，这只是另一个基于考试的系统，或者让孩子参加尽可能多的 AP 课程。这又是一个基于考试的系统。这个例子真实地说明了父母对他们想要什么的看法。然而，他们对孩子的期望是完全不同的。
They often think they want a holistic approach to education, but in reality, they are just swapping one exam-based system for another, and they pay a lot of money for this, so they expect results.	他们通常认为他们想要一种全面的教育方法，但事实上，他们只是在把一种基于考试的系统换成另一种，他们为此付出了很多钱，所以他们期待着结果。

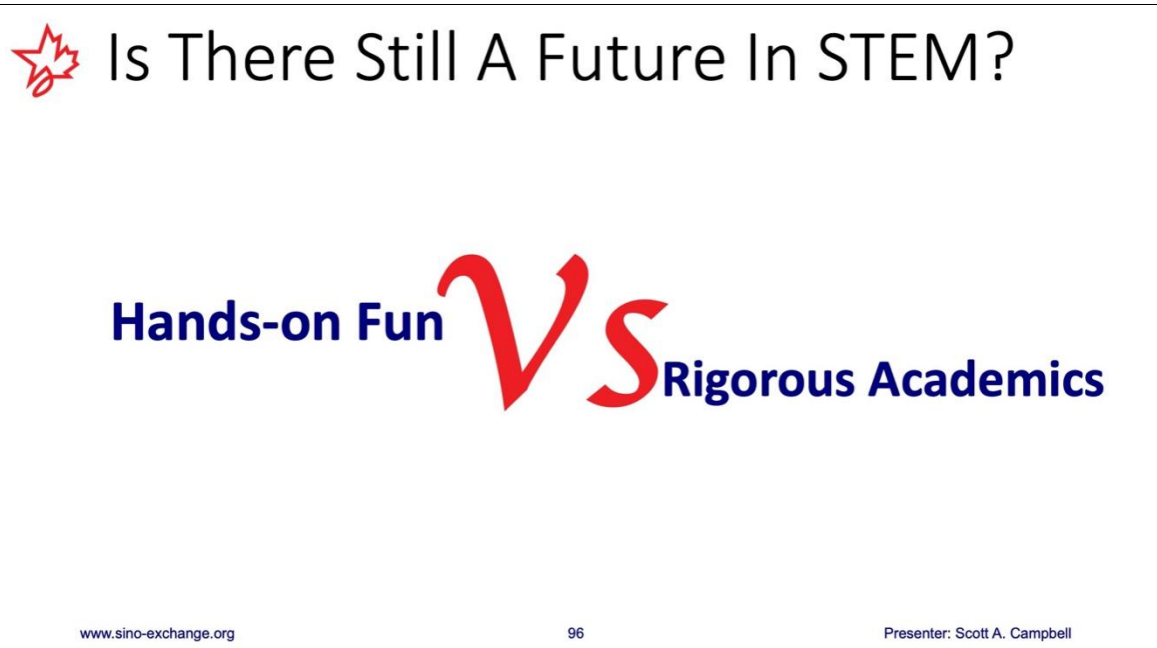


Now the average cost of private education in China now exceeds 20,000 USD per year which is a lot of money! And in Shanghai, that average is over 40,000USD a year.	现在，中国私立教育的平均费用每年超过 20000 美元，这是一大笔钱! 在上海，这一数字平均每年超过 4 万美元。

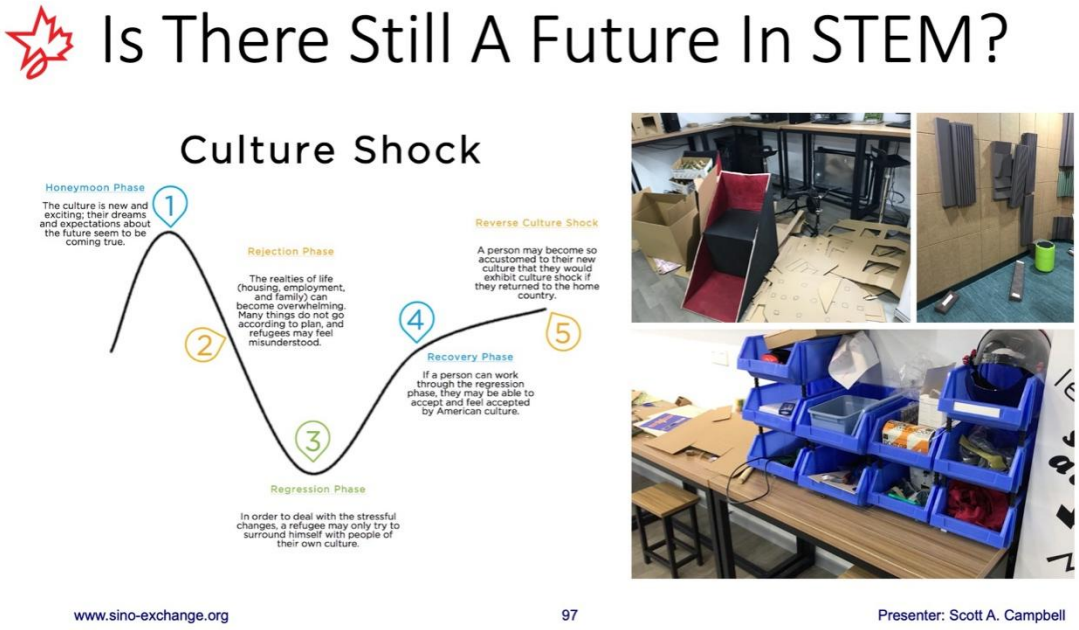


And this notion sheds some light on the recent policy changes to crack down on the private education sector in China. However, the key takeaway here is that there is a lot of money in private education, and parents want to get their money's worth!	这一观点为中国最近打击私立教育部门的政策变化提供了一些启示。然而，这里的关键是，私立教育有很多钱，家长们希望他们的钱物有所值!

Now because the of expectations of parent's which is phenomenally high! Coupled with the costs of tuition, and unprecedented level of competition. School administrators want programs that can sell! Therefore, administrators typically want to see highly marketable programs that show inclusive, and holistic and engaging hands-on activities, and as we saw with in some of these examples, we had inclusive hands-on activities being done in most schools, but many of them were not holistic and they failed to meet appropriate learning outcomes.	现在因为父母的期望是惊人的高！再加上学费，以及前所未有的竞争。学校管理人员想要的是能卖出去的项目！因此，管理人员通常希望看到具包容性、整体性和参与性的实践活动的高度市场化项目，正如我们在其中一些例子中看到的那样，我们在大多数学校都进行了包容性的实践活动，但其中许多活动并不全面，未能达到适当的学习效果。
Which brings me to another key point. There is a difference between showing and doing, and while it is easy to show people that we are providing a STEM program. It's very hard to do it well.	这就引出了另一个关键点。展示和实践是有区别的，尽管向人们展示我们正在提供 STEM 项目很容易。把它做好很难。

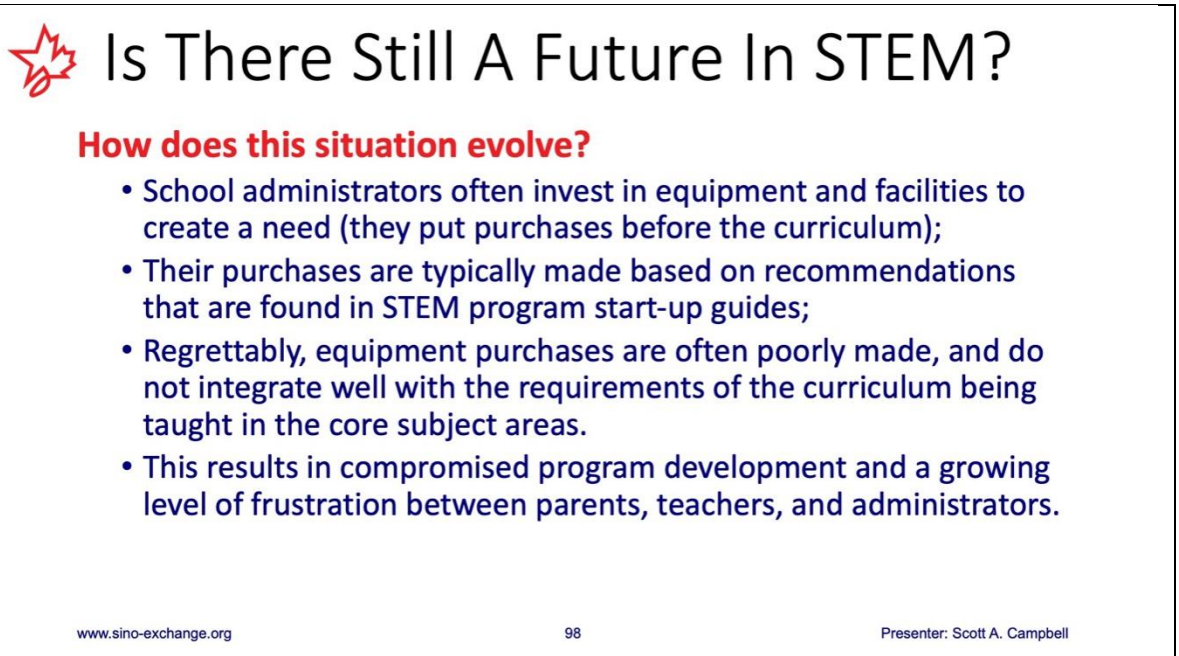


And this brings us to these two ideologies for STEM education that administrators are constantly grappling with. They often think that they want inclusive programs that are fun and engaging, but they also want to give the parents exactly what they want! Which is a rigorous academic program that will improve test scores. However, we often find that these two ideas are incompatible with each other, and this creates a phenomenon that is known as academic culture shock!	这让我们看到了管理者不断努力解决的 STEM 教育的这两种意识形态。他们通常认为他们想要有趣、引人入胜的包容性项目，但他们也想给父母他们想要的东西！这是一个严谨的学术项目，可以提高考试成绩。然而，我们经常发现这两种思想是互不相容的，这就产生了一种被称为学术文化冲击的现象！



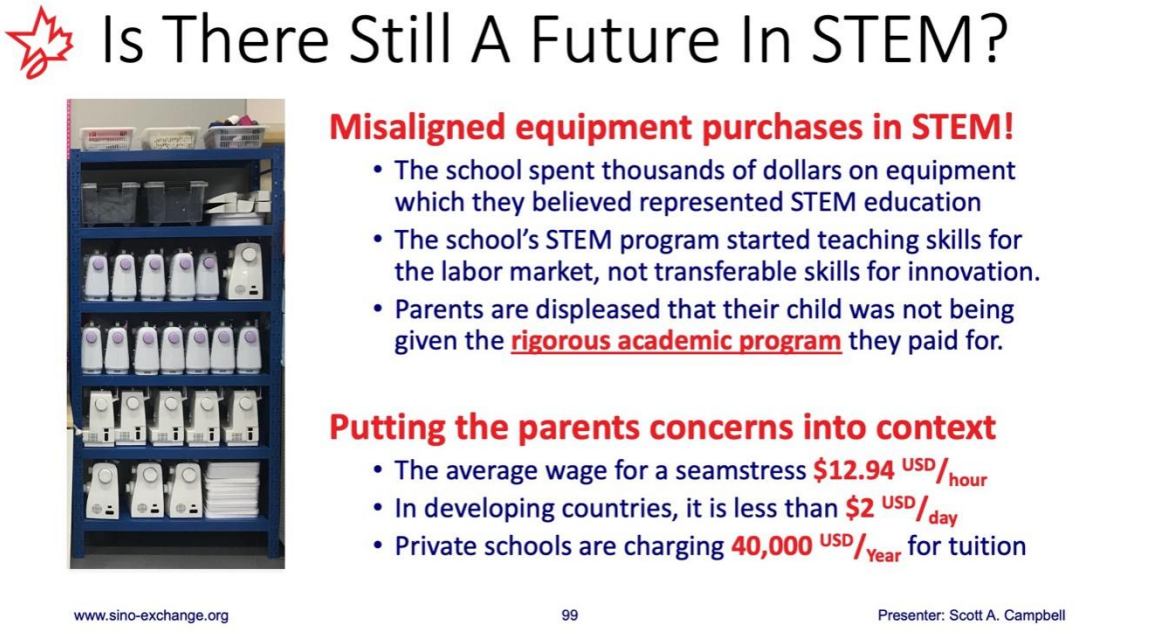
Culture shock always starts with the **“Honeymoon Phase”**, and this is where schools start. There is a lot of excitement around launching a new STEM program and a lot of money gets spent. That’s followed by the **“Rejection Phase”** where schools are expecting to see a positive “**Return On their Investment**” but are often faced with disappointing results that did not meet their expectations! When their multimillion-dollar investment turns into this, a bunch of “**glorified art projects**” and an unmarkable junk pile! Which this brings us to the “**Regression Phase**” where school administrators grapple with the idea of what to do next, and one of 2 things will happen.	文化冲击总是从“蜜月期”开始，而这正是学校开始的地方。推出一个新的 STEM 项目让人兴奋不已，而且花了很多钱。接下来是“拒绝阶段”，学校希望看到积极的“投资回报”，但往往面临着没有达到预期的令人失望的结果！当他们数百万美元的投资变成这样时，一堆“美化的艺术项目”和一堆无法标记的垃圾！这就把我们带到了“回归阶段”，学校管理人员正在努力思考下一步该做什么，两件事中的一件会发生。
Ideally, the responsible parties will sit down identify the problem, and develop a strategic action plan that takes into consideration what the school can feasibly do with their resources while also developing an action plan that is aligned with the school’s vision and objectives. Alternatively, emotions come into play, and this often leads to bad financial decisions as we continue to support the mistakes that we’ve already made. At this point we get trapped by emotional attachments to bad	理想情况下，责任方将坐下来确定问题，并制定一项战略行动计划，考虑到学校可以利用其资源做些什么，同时制定一项符合学校愿景和目标的行动计划。或者，情绪也会发挥作用，当我们继续支持我们已经犯下的错误时，这往往会导致糟糕的财务决策。在这一点上，我们被不良投资的情感依恋所束缚，这些不良投资代表着各种“沉没成本”，这导致的决策只会导致该项目在最终失败之前拖延和耗尽财政资源。

investments which represent various **"Sunk Costs",** and this results in decisions that will only result in the program to drag on and drain financial resources before eventually failing all together.	
This brings me to a conversation with a teacher who was very distraught with what was happening at their school. They were hired as a STEM and Maker Space teacher, but the school had gone through such an emotional roller-coaster with their past implementation strategy that shortly after hiring the teacher. The principals got to the point where they never wanted to hear the word STEM uttered in their school ever again, and that kind of backlash against STEM education is starting to grow as more school's enter the "**Rejection Phase**" due to poorly executed plans.	这让我想起了一位老师的对话，他对学校发生的事情感到非常难过。他们被聘为 STEM 和创客空间的教师，但学校过去的实施策略经历了如此情绪化的过山车，以至于在聘用该教师后不久，校长们已经到了再也不想在他们的学校听到 STEM 这个词的地步，随着越来越多的学校因计划执行不力而进入"拒绝阶段"，这种对 STEM 教育的强烈抵制开始增长。
Regrettably these situations seriously impact the future of STEM education and will continue to do so unless we start taking immediate action to solve the problem!	令人遗憾的是，这些情况严重影响了 STEM 教育的未来，除非我们立即采取行动解决问题，否则这种情况将继续下去！



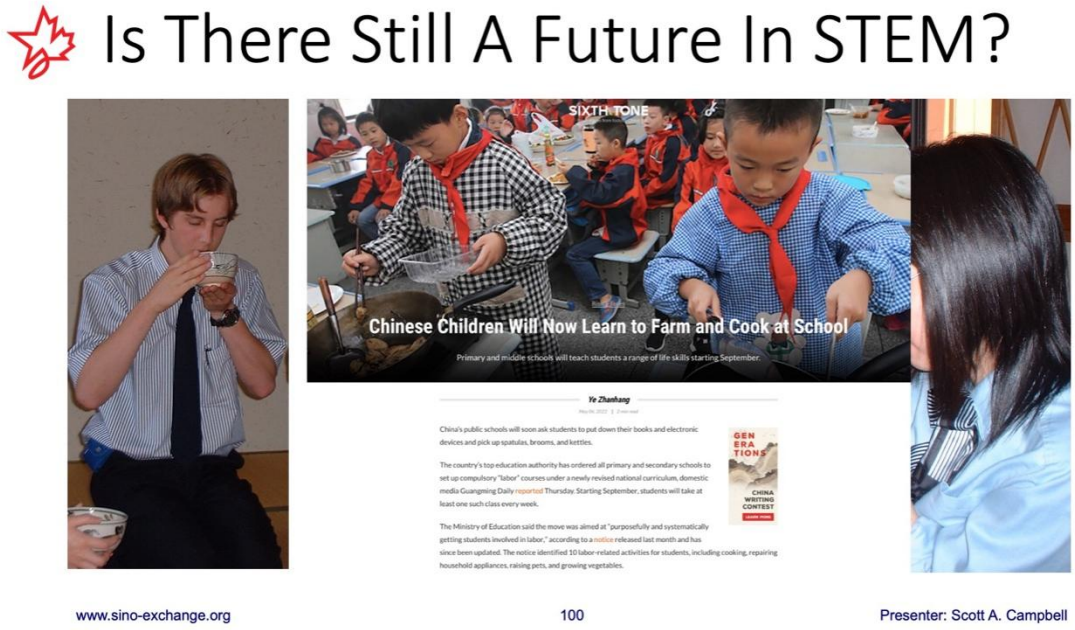
How does this situation come to pass? It starts when school administrators often invest in equipment and facilities to create a need rather than starting with the development of a curriculum and then making strategic purchases to support the desired learning outcomes of that curriculum, and they do this as they want to get a program up and running a quickly as possible. Generic purchasing guides are typically used in these kinds of situations. But this approach is very naïve because these purchasing guides will not take into consideration limiting factors such as: • the amount of space the school has. • the finances available to run the program. • the number of students which can be enrolled. • or the expertise of the teachers who will eventually teach the program. Moreover, most of these purchasing guides are published by the very companies that sell the equipment, and they don't care about the development of the school's curriculum. They only care about their bottom line. How much can the sell, and how much money they can make selling it!	这种情况是怎么发生的? 它始于学校管理人员经常投资设备和设施来创造需求，而不是从开发课程开始，然后进行战略购买以支持该课程的预期学习成果，他们这样做是因为他们希望尽快启动并运行一个项目。通用采购指南通常用于这类情况。 但这种方法非常天真，因为这些购买指南不会考虑限制因素，例如: • 学校的空间大小。 • 可用于运行该计划的资金。 • 可招收的学生人数。 • 或最终教授该课程的教师的专业知识。 此外，这些购买指南大多是由销售设备的公司发布的，他们不关心学校课程的发展。他们只关心自己的底线。他们能卖多少钱，卖了能赚多少钱!

Next teachers are then brought to teach a program, and they often complain that they don't have the appropriate materials that are needed to teach the curriculum. As a result, project development often resorts to the lowest common denominator which is typically results in the development of glorified "**arts and crafts**" projects. And finally, this results in compromised program development and a growing level of frustration between parents, teachers, and school administrators.	接下来，老师们被带去教授一个课程，他们经常抱怨自己没有教授课程所需的合适材料。因此，项目开发往往采用最低公分母，这通常会导致开发美化的"工艺美术"项目。最后，这导致项目开发受到影响，家长、教师和学校管理人员之间的挫败感越来越大。

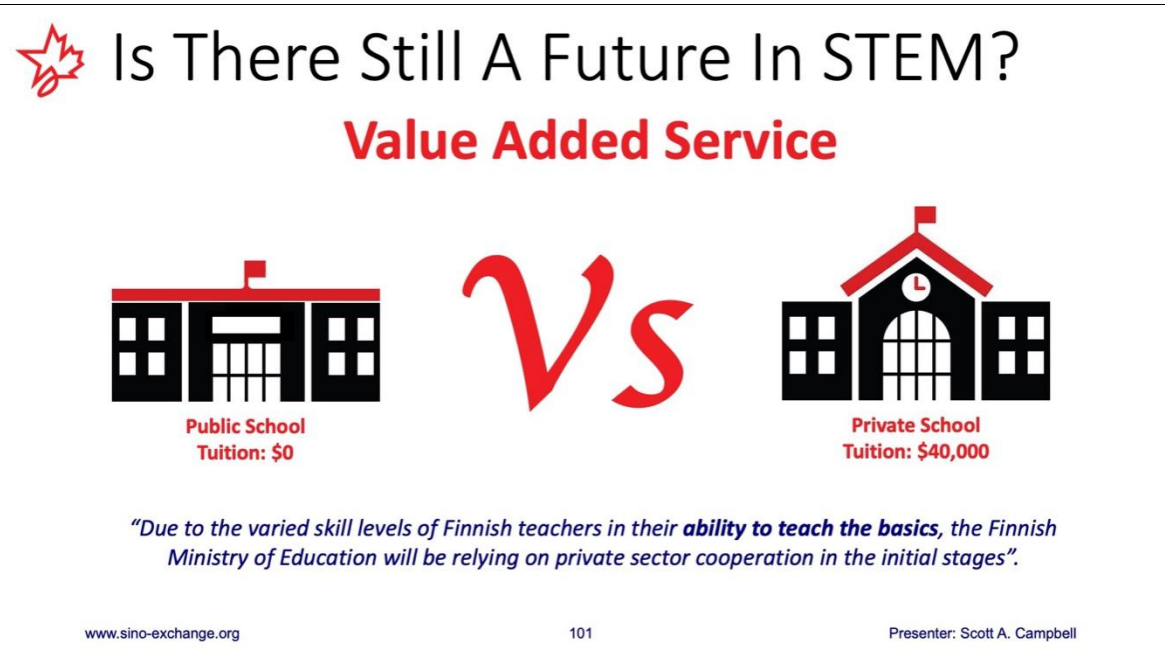


Now let's look at some examples misaligned equipment purchases that resulted from using easy start guides for STEM education. In this example the school spends thousands of dollars on equipment which they believe represents STEM education. They thought that this would provide authentic hands-on learning experiences which would support what parents wanted from a premium private education.	现在，让我们来看看一些由于使用 STEM 教育的简易入门指南而导致的设备购买错位的例子。在这个例子中，学校在他们认为代表 STEM 教育的设备上花费了数千美元。他们认为，这将提供真正的动手学习体验，支持家长从优质私立教育中获得的东西。
In this photo we can see a class set of Singer sowing machines which are incredibly expensive top-of-the-line sowing machines. But is this purchased aligned with the development of rigorous academic standards that will get the child into a top university? Afterall, this is typically why parents will pay such high premiums for private education.	在这张照片中，我们可以看到一组辛格播种机，它们是非常昂贵的顶级播种机。但是，这是否与严格的学术标准的发展相一致，从而使孩子进入顶尖大学？毕竟，这就是为什么家长会为私立教育支付如此高的费用。
In this example the school started teaching skills for a labor general market, and this is because they naively thought that hands on learning is the same thing as STEM education. However, this kind of skill set is misaligned with what they parents expect for their child's future. As a result, parents are likely to become displeased that their	在这个例子中，学校开始为劳动力市场教授技能，这是因为他们天真地认为实践学习与 STEM 教育是一回事。然而，这种技能与父母对孩子未来的期望不一致。因此，父母可能会对孩子没有得到他们所支付的严格的学术课程感到不满。

child is not being given the rigorous academic program they've paid for. Now let me put the parents' concerns into context for you. The average wage for a seamstress $12.94 USD/hour which is just about the poverty line, and in developing countries it's less than $2 USD/day. However, some private schools are charging more than $40,000 a year for tuition! Therefore, parents that spending this kind of money on a private education are expecting rigorous academic programs that will help their child get into the best university possible, and for their child to go on and get a high paying job! They are not typically going to invests thousands of dollars for their child to learn skills for a general labor market unless there is a good reason. And that raises another good point. Not all schools need to focus on getting every student into universities like Harvard, Yale, Princeton, or Oxford. There is need for schools that serve a niche market and we do see this with some of the private charter schools in the United States. However, serving a niche market needs to be part of your strategic vision and educational philosophy and not an accidental after thought.	现在，让我为您介绍一下家长们的担忧。一名女裁缝的平均工资为 12.94 美元/小时，大约相当于贫困线，而在发展中国家，这还不到 2 美元/天。然而，一些私立学校的学费每年超过 4 万美元！因此，把这笔钱花在私立教育上的父母期待着严格的学术课程，这将帮助他们的孩子进入尽可能好的大学，并让他们的孩子继续前进，找到一份高薪工作！除非有充分的理由，否则他们通常不会为孩子投资数千美元来学习一般劳动力市场的技能。 这提出了另一个好的观点。并不是所有的学校都需要专注于让每个学生进入哈佛、耶鲁、普林斯顿或牛津等大学。需要为利基市场服务的学校，我们确实在美国的一些私立特许学校中看到了这一点。然而，为利基市场服务需要成为你战略愿景和教育理念的一部分，而不是事后的偶然。



Let me reiterate before moving on that there is nothing wrong with having sowing lessons in school. I myself had to take a mandatory **"life skills class**" when I was in school in Japan. In this class we learnt how to drink green tea properly, manage our personal finances, how to cook basic meals, and yes… we also learnt how sow as well. But we learnt how to sow a button on our shirts, or repair ripped seam in our pant leg, and this cost almost nothing to teach using a needle and thread. Moreover, it also had practical real-world applications. However, this wasn't by any means called STEM education, it was called life skills. Moreover, the skills we learnt were not to prepare us go an unskilled labor market. Instead, these lessons were designed to help us learn practical skills that we would likely need in everyday life regardless of what profession we went into. And finally, China has also recently just announced changes to their education system that will see all children receive life skills classes as part of their K-9 public education.	在继续之前，请允许我重申，在学校里播种课程没有错。当我在日本上学的时候，我自己不得不参加一个强制性的"生活技能课程"。在这节课上，我们学会了如何正确饮用绿茶，管理个人财务，如何烹饪基本膳食，是的……我们还学会了如何播种。 但我们学会了如何在衬衫上扣扣子，或者修复裤腿上撕裂的接缝，而这几乎不需要用针线来教。此外，它在现实世界中也有实际应用。然而，这绝不是 STEM 教育，而是生活技能。此外，我们学到的技能并不是为了让我们进入非熟练劳动力市场。相反，这些课程旨在帮助我们学习日常生活中可能需要的实用技能，无论我们从事什么职业。最后，中国最近刚刚宣布对其教育体系进行改革，所有儿童都将接受生活技能课程，作为 K-9 公共教育的一部分。

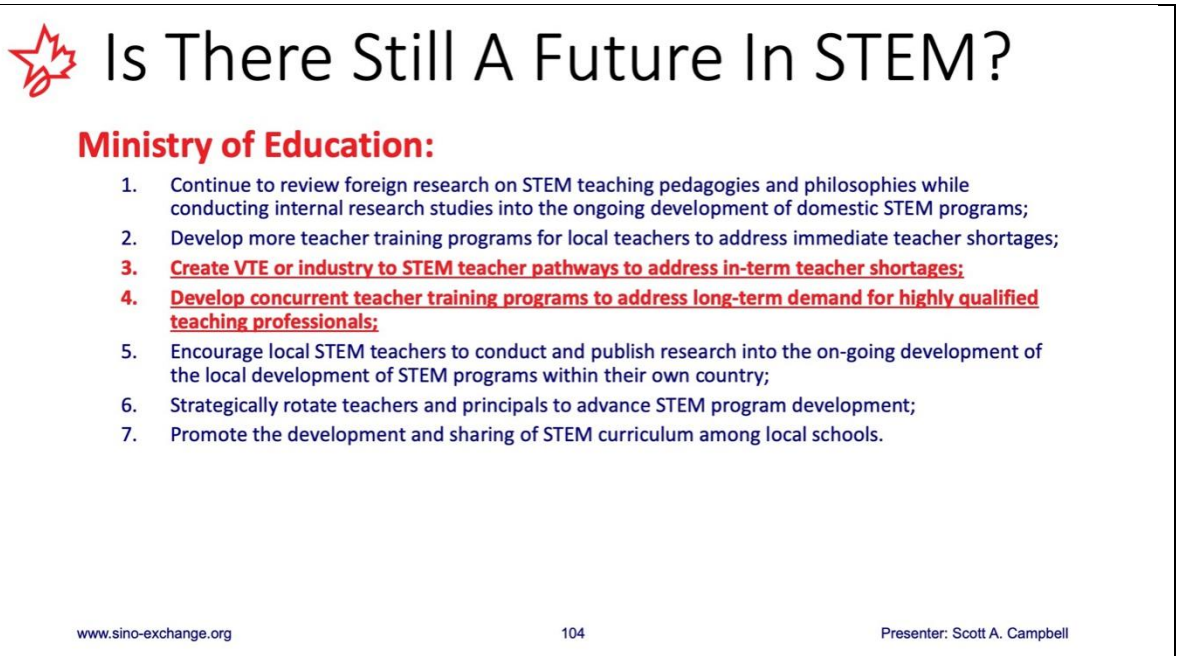


Now the last point that I have time to make is regarding "value added services". The key thing to keep in mind here is that something which might be considered a wise decision for one school may not be considered acceptable other schools and this is particularly true of public institutions which offer free education vs private institutions that come at a hefty price tag.	现在，我有时间提出的最后一点是关于"增值服务"。这里需要记住的关键是，对一所学校来说可能是明智的决定，但对其他学校来说可能不可接受，尤其是提供免费教育的公立机构与价格高昂的私立机构。
Let me give you an example. As we saw with the Finish Ministry of Education, they were concerned about their teacher's ability to teach the basics. Now if the Finish government paid for an interactive programing subscription for use in a free public school, then they've proved a **"value added service"** to the parents. However, if a private school which charges $40,000 dose the exact same thing the parents will probably be outraged, and that's because the parent could have just bought that subscription for themselves for far less than what they are paying for their child to go to a primum private school. Therefore, the private school hasn't provided any **"value added services"** to the parents that would justify the tuition.	让我给你举个例子。正如我们在教育部看到的那样，他们关心老师教授基础知识的能力。现在，如果芬兰政府为免费公立学校的互动节目订阅付费，那么他们已经证明了对家长来说是一项"增值服务"。然而，如果一所收费 4 万美元的私立学校做同样的事情，家长们可能会感到愤怒，因为家长们可以为自己购买订阅，而不是为孩子上一流私立学校支付费用。因此，私立学校没有向家长提供任何"增值服务"来证明学费是合理的。

However, let me provide another example to illustrate this idea slightly better before moving on.	然而，在继续之前，让我提供另一个例子来更好地说明这个想法。
Most of us love the 4-dollar hamburger from our favorite fast-food restaurant. And it this price it does provide value for money. However, if we were to take that same hamburger and serve it in a luxurious restaurant it will still be a 4-dollar hamburger. We haven't added any value to that product or service.	我们大多数人都喜欢我们最喜欢的快餐店的 4 美元汉堡包。 这个价格确实物有所值。然而，如果我们拿着同样的汉堡在豪华餐厅里吃，它仍然是一个 4 美元的汉堡。我们没有为那个产品或服务增加任何价值。
This is a real example from a few years that drew a lot of attention. However, it's by no means a sustainable business model and that is one thing you need to think about when developing specialty programs for your school. Are you creating "Value for Money", because if you're not then your business model will not be sustainable for long. Therefore, let me reiterate this point, what's appropriate for a free public school, may not be acceptable for an expensive private school. You need to make sure that you are adding value to the products or services that you are offering your clients as they will expect to get their money's worth!	这是几年来吸引了大量关注的一个真实例子。然而，这绝不是一种可持续的商业模式，这是你在为学校开发专业课程时需要考虑的一件事。你是否在创造"物有所值"，因为如果你不这样做，那么你的商业模式将无法长期持续。因此，让我重申这一点，对于一所免费的公立学校来说合适的东西，对于一所昂贵的私立学校来说可能是不可接受的。你需要确保你为客户提供的产品或服务增加了价值，因为他们希望他们的钱物有所值！

Therefore, you will need to make complex decisions that go way beyond educational management, and into the realms of business management. Only then will you be to strike the balance that is needed to create strategic business plans that also uphold your educational objectives.	因此，你需要做出复杂的决策，这些决策远远超出了教育管理的范畴，进入了商业管理的领域。只有这样，你才能在制定战略商业计划时取得平衡，同时维护你的教育目标。

Let's wrap things up with a series of recommendations.	让我们用一系列的建议来总结一下。
I spent 6 years doing my MBA, focusing my studies on the development of STEM programs here in China, and part of the reason spent so long on my master's degree was so I could as many schools as possible. This allowed me more time to gather data and validate ideas over an extended period of time. Therefore, before we conclude today's presentation, I want to share with you a few take aways form my dissertation.	我花了 6 年时间攻读 MBA，专注于中国 STEM 项目的发展，花这么长时间攻读硕士学位的部分原因是为了尽可能多的选择学校。这让我有更多的时间在更长的时间内收集数据和验证想法。因此，在我们结束今天的演讲之前，我想和大家分享一些我从论文中摘录的东西。
Ironically, a lot of the ideas in this list seem like common sense. However, I'm sure that you are aware of the saying "common sense isn't all that common!"	具有讽刺意味的是，这份清单中的很多想法似乎都是常识。然而，我相信你知道这句话"常识并不那么普遍！"



Let's start with recommendations that would be implemented by the Ministry of Education:

1. Continue revieing foreign research on the development of STEM teaching pedagogies while conducting internal research studies into the ongoing development of domestic STEM programs.

2. Develop more teacher training programs for local teachers to address immediate teacher shortages.

3. Create VTE or industry to STEM teacher pathways to address in-term teacher shortages, and this is something that we saw is happening in Canada, and as the PISA results show, they must be doing something right.
4. Develop concurrent teacher training programs to address long-term demand for highly qualified teaching professionals.

5. Encourage local STEM teachers to conduct and publish research into the on-going development of STEM programs within their own country

让我们从教育部将要实施的建议开始：

1. 继续审查国外对 STEM 教学法发展的研究，同时对国内 STEM 项目的持续发展进行内部研究。

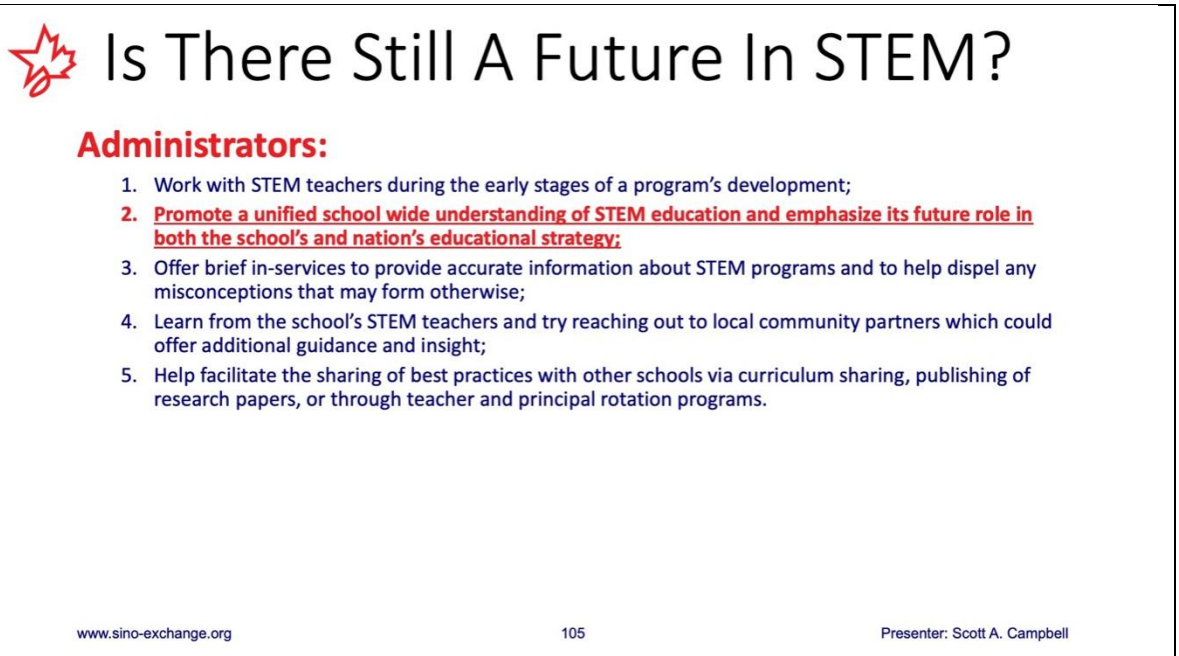
2. 为当地教师制定更多的教师培训计划，以解决当前教师短缺的问题。

3. 创建 VTE 或行业到 STEM 的教师途径，以解决学期内教师短缺的问题，这是我们在加拿大看到的事情，正如 PISA 的结果所示，他们必须做正确的事情。

4. 制定并行的教师培训计划，以满足对高素质教学专业人员的长期需求。

5. 鼓励当地 STEM 教师对本国 STEM 项目的持续发展进行研究并发表研究，这是对当地中国教师的要求，我认为这是确保教师持续专业发展的宝贵策略。尤其是在 STEM 教育等要求苛刻的行业。

which is a requirement for local Chinese teachers, and I think this is a valuable strategy to ensure continued professional development of teachers. Particularly in demanding sectors such as STEM education.	
6. Strategically rotate teachers and principals to advance STEM program development. Again, this is a strategy that the Chinese government has put in place to help ensure the development of high-quality educational programs nationwide.	6. 战略性地轮换教师和校长，以推进 STEM 项目的开发。同样，这是中国政府为确保全国高质量教育项目的发展而制定的一项战略。
7. And finally, to start promoting the development and sharing of STEM curriculum among local schools.	7. 最后，开始促进当地学校之间 STEM 课程的开发和共享。



The next set of recommendations are for administrators:

1. It's important for administrators to work with STEM teachers during the early stages of a program's development. Now although this sounds obvious, it doesn't happen that often. Particularly at private schools as administrators typically start with a mass investment to get the program going before hiring a teacher for the program.

2. Promote a unified school wide understanding of STEM education while also emphasizing the future role STEM has in the school's long-term educational strategy, and while this is incredibly important, it hardly ever happens in practice.

3. Offer brief in-services to provide accurate information about STEM programs to help dispel any misconceptions that may form otherwise. Again, reaching out to community partners can have a huge impact on teaching and learning. However, we don't see this happening much anymore which is very

下一组建议适用于管理员：

1. 在项目开发的早期阶段，管理人员与 STEM 教师合作非常重要。虽然这听起来很明显，但这种情况并不经常发生。尤其是在私立学校，管理人员通常在为该项目聘请教师之前，先进行大规模投资，以推动该项目的实施。

2. 促进学校对 STEM 教育的统一理解，同时强调 STEM 在学校长期教育战略中的未来作用，尽管这非常重要，但在实践中几乎从未发生过。

3. 提供简短的服务，提供有关 STEM 项目的准确信息，以帮助消除可能形成的任何误解。同样，接触社区合作伙伴可以对教学产生巨大影响。然而，我们不再看到这种情况发生，这是非常不幸的，因为我们看到了合作对 70 年代、80 年代和 90 年代 VTE 项目的好处。

unfortunate because we saw the benefits that collaboration had for the VTE programs in the 70's, 80's and 90's. 4. Learn from the school's STEM teachers and try reaching out to local community partners which could offer additional guidance and insight. 5. And finally, try sharing best practices with other schools via curriculum sharing, publishing of research papers, or through teacher and principal rotation programs, and this is something that the Ministry of Education in China is trying to encourage through the introduction of new educational policies. However, it can be very difficult to encourage private schools to collaborate with one another when they are in direct competition with each other.	4. 向学校的 STEM 老师学习，并尝试联系当地社区合作伙伴，他们可以提供更多的指导和见解。 5. 最后，尝试通过课程共享、发表研究论文或通过教师和校长轮换计划与其他学校分享最佳实践，这是中国教育部试图通过引入新的教育政策来鼓励的。然而，当私立学校之间存在直接竞争时，很难鼓励它们相互合作。

Is There Still A Future In STEM?

Purchasing Departments:

1. Avoid making uninformed purchasing decisions;
2. Work with STEM teachers to make relevant equipment purchases;
3. **Make purchases that support strategic learning outcomes;**
4. Look at making complementary equipment purchases;
5. Work with teachers and IT departments to avoid compatibility issues, or develop support strategies to aid in the successful implementation of new technologies;
6. Avoid investing in proprietary equipment architectures.
   (If this kind of investment is necessary, invest heavily into one system architecture to avoid unnecessary diversification into similar yet incompatible ecosystems)

Next are recommendations for Purchasing Departments:

1. Avoid making unformed purchasing decisions. Again, this seams incredibly obvious, but most purchasing decisions are made by finance departments that do not understand the details of the purchase and this often leads to a lot of bad purchasing decisions or substitutions.

2. Work with STEM teachers to make relevant equipment purchases.

3. Make purchases that support strategic learning outcomes, and as we saw, many schools rely on **'Easy Start Guides"** to build a program which only results in buying equipment and then trying to make a need for it. However, quality programs start by developing the desired learning outcomes and then will look at ways to make strategic purchases that support the desired learning outcomes of the program.

4. Look at making complementary equipment purchases.

接下来是对采购部门的建议：

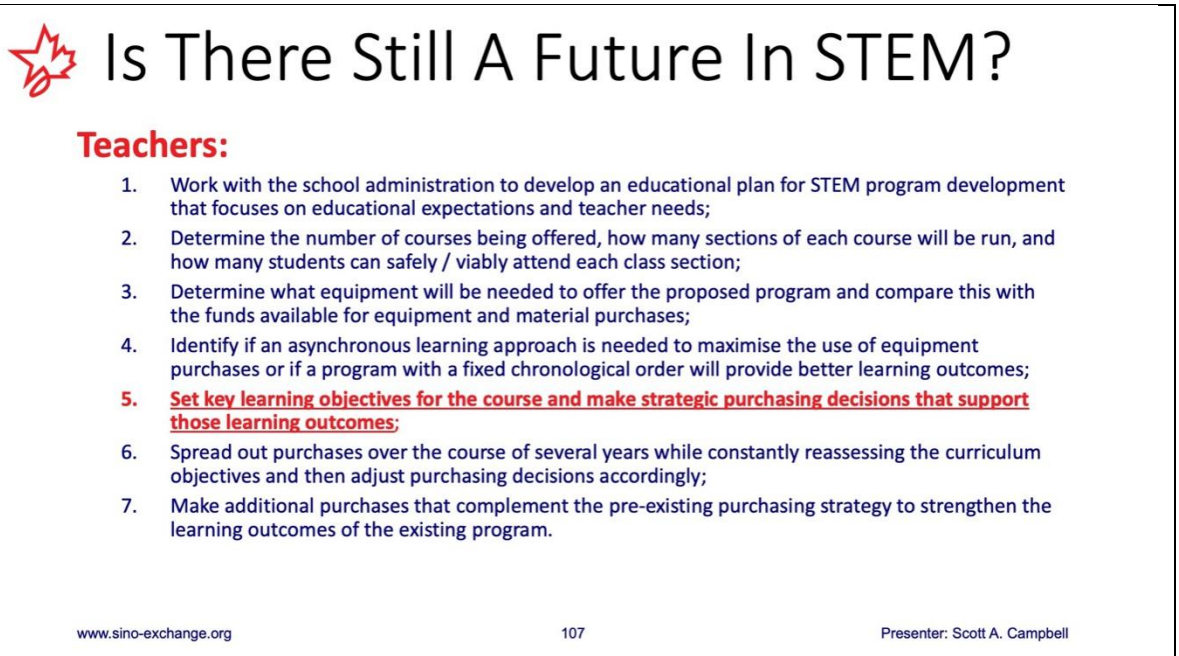
1. 避免做出未成形的采购决策。同样，这种接缝非常明显，但大多数采购决策都是由不了解采购细节的财务部门做出的，这往往会导致许多糟糕的采购决策或替代。

2. 与 STEM 教师合作购买相关设备。

3. 购买支持战略学习成果的设备，正如我们所看到的，许多学校依靠"简易入门指南"来建立一个只会导致购买设备，然后试图满足需求的项目。然而，高质量的项目从开发所需的学习成果开始，然后会寻找支持项目所需学习成果的战略购买方法。

4. 考虑购买配套设备。

5. Work with teachers and IT departments to avoid compatibility issues or develop support strategies to aid in the successful implementation of new technologies as compatibility issues are some of the biggest issues that I see on a regular basis. Part of this results from uniformed purchasing decisions being made by the school but let me give you an example this. Many schools are implementing a 1-to-1 or BYOD program for students. These programs are often centered around the school-wide use of Apple computers. however, equipment is purchased for the school's STEM program that is only compatible with Windows computers. Again, it seems obvious, and yet this is happening in most of the schools that I have worked with over the years. 6. And finally, avoid buying into proprietary equipment architectures, or if this kind of investment is necessary, invest heavily into one system architecture to avoid unnecessary diversification into similar yet incompatible ecosystems.	5. 与教师和 IT 部门合作，避免兼容性问题，或制定支持策略，以帮助新技术的成功实施，因为兼容性问题是我经常看到的一些最大问题。部分原因是学校做出了统一的采购决定，但让我举一个例子。许多学校正在为学生实施一对一或 BYOD 计划。这些程序通常以学校范围内使用苹果电脑为中心。然而，为学校的 STEM 项目购买的设备仅与 Windows 计算机兼容。同样，这似乎很明显，但这些年来，我合作过的大多数学校都发生了这种情况。 6. 最后，避免购买专有设备架构，或者如果这种投资是必要的，则对一个系统架构进行大量投资，以避免不必要的多样化进入类似但不兼容的生态系统。



And the last section is about recommendations that teachers can use. 1. Work with the school administration to develop an educational plan for STEM program development that focuses on educational expectations while also supporting the teacher's needs. 2. Determine the number of courses being offered, how many sections of each course will be run, and how many students can safely or viably attend each class section. 3. Determine what equipment will be needed to offer the proposed program and compare this with the funds available for equipment and material purchases. 4. Identify if an asynchronous learning approach is needed to maximize the use of equipment purchases or if program with a fixed chronological order will provide better learning outcomes. 5. Set key learning objectives for the course and make strategic purchasing decisions that support those learning	最后一节是关于教师可以使用的建议。 1. 与学校行政部门合作，制定 STEM 项目开发的教育计划，重点关注教育期望，同时支持教师的需求。 2. 确定提供的课程数量，每门课程将开设多少节，以及有多少学生可以安全或可行地参加每节课。 3. 确定提供拟议计划所需的设备，并将其与可用于设备和材料采购的资金进行比较。 4. 确定是否需要异步学习方法来最大限度地利用设备采购，或者确定固定时间顺序的程序是否能提供更好的学习结果。 5. 为课程设定关键的学习目标，并做出支持这些学习成果的战略采购决策。

outcomes. 6. Spread out purchases over the course of several years while constantly reassessing the curriculum objectives and then adjust purchasing decisions accordingly. 7. Make additional purchases that complement the pre-existing purchasing strategy to strengthen the learning outcomes of the existing program.	6. 在几年内分散购买，同时不断重新评估课程目标，然后相应地调整购买决策。 7. 进行补充现有购买策略的额外购买，以加强现有课程的学习成果。

So that brings us to the end of this presentation of **"Is There Still A Future In STEM - and what we can do to fix the problem!"** I hope that you enjoyed and learnt a lot from this presentation and that you will enjoy all the hands-on activities that we have planned for you throughout the rest of the symposium.	今天的主题是"STEM 还有未来吗？我们能做些什么来解决这个问题！" 我希望你们喜欢并从这次演讲中学到了很多，也希望你们会喜欢我们在接下来的研讨会中为你们安排的所有实践活动。