SAGE 联盟

Journal 2013 + 研究专著 2013

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以“体验式学习”为核心过程的课程初探

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初闻“体验式学习”这一名词，是随附中学生参加南洋女中的乌敏岛体验式学习活动。虽然整个学习过程只有一天，但是学生在体验前后发生的行为、情感变化却是显著的。这个发现令我很兴奋，难道这是一种我们从未使用，而又高效实用的教学方法吗？经过反思和对比，我发现如果把“体验式学习”定义为学生通过感官感知、情感变化进行体验，并在体验中达到学习目标的过程。那么国内学生经历的“体验式学习”并不少，军训、社会实践、社区服务课程、各种夏令营、各种拓展活动其实都是有组织的“体验式学习”。然而国内外的体验式学习在目标上是否一致，内容上有何不同，组织形式上各有何特色，最终效果上存在什么差异，这些问题都可以作为我们探讨的话题。本文仅以一些案例为材料对体验式学习的过程做初步的探讨。

以“体验式学习”为核心过程的课程设计

“体验式学习”本身并不是一门课程，而是一种学习过程，或者说是一种学习方式，教师可以让学生通过体验式学习达到课程的学习目标。和“讲授式”、“讨论式”教学一样，体验式学习也有它适用的条件。在实践类课程中，我们需要学生去亲身体验进行学习，积累和丰富直接经验，所以在这类课程中“体验”的过程就是核心过程，然而课程的目标达成也不可能仅依靠“体验”就能够实现，还要配合其他学习方式，因此以“体验式学习”为核心过程的课程要经过精巧的设计才能让学生在体验之前有所思，在体验之中有所悟，在体验之后有所为。

体验之前有所思

在课程设计时一定要先将目标明确，并且结合课程目标提出一些核心问题，让学生在体验之前思考、讨论这些核心问题，并得到一些确定或不确定的想法，最终在体验中去验证这些想法。我所接触的一个典型案例是新加坡莱佛士书院的领袖夏令营，这个夏令营课程目标很专一，就是培养学生的领袖素质，而对于这个目标的细化并不简单，课程负责人会在课程设计之前进行涉及面很广的深入调查，综合调查结果与课程教师进行讨论来确定课程中究竟要培养怎样的领袖。而把这个课程带到中国来上，又要根据中国的国情进行目标的修订讨论，而他们的课程小组确实在课程的设计之初就完成了这些必要的准备工作。这样做的好处就是能够顺利的提出具体的核心问题，比如“Why bad things happen?”，您可能会疑惑领袖夏令营不就是培养领导吗，学学怎么管人就行了，关注坏事为什么发生干什么，因为在设计过的课程中，领袖是要为社会服务的，当然要关心社会中的坏事怎么产生，才能够从根本上来解决。这样的核心问题在这次领袖夏令营中有不少，都是针对课程目标提出来的。想想我们在设计实践活动课程的时候，是不是很少把目标具体到问题，就开始进行教学了呢，最后学生把社会实践、社区服务做成了无思考的义务劳动，问题可能就出在这，他们少了“体验”前的“思”。

在体验之中有所悟

如果说体验前的“思”决定了整个课程的方向，那么真正的体验过程就一定要针对前面所思的内容来进行设计，让学生在体验中验证自己先前的所思，让实践学习既不空想，也不白干。也举一个典型案例，北大附中的实践课程采取学生自主组队申请项目，教师审批，项目运行，项目总结、评价的流程进行，我和实践中心的老师设计了这个流程的网上操作平台，这个平台半年间处理了577份项目申请，共有1249人次的学生参与其中，而运行平台的只有我一人，这也可以看出信息化在实践类课程中的强大辅助作用。我遇到的一个社区服务项目是几名学生想在年级中成立学习小组，该小组为本年级或更低年级的学生提供答疑服务。于是我和他们小组的负责人进行项目实施前的讨论，同学们需要这样的服务吗？你们的服务能满足同学们的需求吗？同学们怎样能够得到你们的服务？怎样说明你们进行了足量、优质的服务？怎样衡量你们服务的有效性？实际上在这几个问题的讨论过程中，学生就要回答在社区服务中的几个核心问题，服务对象对服务的需求、服务团队的能力要求、服务过程的设计以及服务结果的评价，只不过根据他们的初步意向，我们把问题具体化了。通过讨论几位同学有了基本的设想，比如做项目之前先做调查，根据调查结果评估项目可行性，如果可能的话，加大宣传力度（讨论的时候还没有方案），通过记录的方式说明服务的真实过程，通过服务对象的满意度调查说明效果等。后来，他们经过调研，确定了需求的可行性，真的把项目做了一个学期，也经历过门庭冷落，也想了各种办法打广告，并且通过电邮、短信、电话的方式扩大了服务范围和记录方式，最后所有参与学习小组的人服务时间均超过了40小时。而通过在这一学期中所体验的期待、兴奋、迷茫、焦虑、感动、喜悦与成就，他们对服务有了更深刻的认识，不求回报的服务、智慧的服务、自始至终的服务在他们的项目总结中得到了充分的体现，这就是他们在体验中所悟到的。而我的工作就是引导学生悟的方向。

第二个案例，是领袖夏令营中的一个体验过程，教师和学生进行角色扮演，教师作为富商邀请同学扮演的宾客赴宴，但是宾客被分为了三个等级：大多数宾客是穷人，只能席地而坐，他们的午饭是白粥；少部分宾客是中产阶级，他们8人共用一个餐桌，有家常菜；而极少数宾客是贵宾，有高档西餐和专门的服务生。虽然只是角色扮演，但是当学生真正坐在地上开始分粥的时候，那种体验和听故事是不一样的。午餐中，又安排了抽签，一位贵宾发生了变故成为了穷人，而几名穷人成了中产，他们交换位置继续午饭。最后让各个阶层的学生讨论，表达各自的需求，扮演穷人的学生会为了得到一张椅子而与中产学生讲“平等”，而中产的学生会用“自由”为自己辩护，他们的认真程度绝对超乎你的想象，我想如果只是讨论社会资源的分配，小“领袖”们一定会有很多高谈阔论，但是真正到了自己扮演特定角色时，利益的冲突就可以真正“体验”到了。在这次学习中，教师很好的设计了体验式学习的过程，即使是模拟也一定让学生从感官到情绪上都受到冲击。

有关体验中的最后一个案例是乌敏岛的体验式学习，尽管只有一天的学习时间，但是在每一个体验环节过后，教师都会组织一次短暂的集会，让学生们表达前一环节中自己的感受与想法，有的只是随意交流，有的是针对他提出的问题进行回答，这些问题可能是刚才在乡间的小路旁边你都看到了什么？静静坐在这1分钟，你都听见什么？让雨淋湿有什么感觉？怎样划船才能够向前行进？你会发现这些问题可能并不那么“专业”，不是让学生识别植物的名称、鸟类的鸣叫，也不是让学生成为划船的运动员，但是这些问题却能够让学生关注周围的环境，并且把自己当做是其中的一员，这不是生物课，而是一门人与自然的感知课。这种感知，也许并不能让学生在学业中有明显的进步，但是如果这些学生成了未来的领导者，那么他们的决策关注到自然的可能性就会增加，哪怕只是一点可能性，我认为这次体验也是值得的。

在体验之后有所为

“有所为”也并不是说在体验之后一定要有多么大的作为，而是知行合一的意思，最普遍的方式就是与他人分享，莱佛士书院的自然类实践课程，学生将搜集的自然景象、故事用自己原创的画册传递给社会，出版读物供幼儿阅读；社会调研类的实践课，学生将自己的体验过程与思考结果与同学们分享。北大附中的博物课上，学生有机会在专业研究者的指导下接触自然保护区中的广博物类，每年参与课程的学生也会编辑一本博物合集，既是记录体验中的点滴，也是与别人共享自己的收获。让别人体验自己的体验是一种分享，而体验别人的体验也是一种学习。

以“体验式学习”为核心过程的课程教师

组织附中的实践课程、亲身体验了新加坡学校的体验式学习后，我有一个突出的感觉，就是在以“体验式学习”为核心过程的课程中，国内的教师基本上都是兼职的，而新加坡的教师都是专职的，由于兼职教师的流动性，课程教师一换，已经成型的课程很容易受影响，而且教师的经验也不能够得到充分的积累，其实我们的国家课程中明确将“综合实践活动”作为必修课程，但是并没有师范院校培训相应师资，也没有相应科目的教师资格认定，所以要推动实践课程的教师专业化，在社会、学校的制度上都要给与支持。

“实践出真知”，体验式学习是实践类课程的核心过程，体验本身需要精心设计，而体验的“前因”、“后果”也需要教师仔细引导。教育是对人的影响，而感官感知和情感情绪是对人产生最直接影响的学习过程，体验式学习正是利用这一点才让学生产生了不同于逻辑推理的认知，体验的价值不可小视。

新加坡“双文化”课程“少教多学”蠡探

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新加坡“少教多学”理念与“双文化”课程渊源深厚： 2004年8年李显龙就任总理伊始，就在国庆群众大会上就对新加坡教育提出两点改革意见：一是”少教多学”教育理念：“我们得少教一点，让学生多学一点。成绩诚然重要，考试一定要及格，但成绩不是生命的唯一大事。在学校里，还有许多生活上的事物，值得我们去学习。”[1]以此为滥觞，2005年教育部正式成立“少教多学委员会”，2006年开发出由教学法（Pedagogy）、学习体验（Experience of Learning）、学习环境的氛围（Tone of Environment）、评价（Assessment）、教学内容（Learning Content）等五大模板组成的投入型学习框架（简称“PETALS”）[2]。另一项教学改革就是“双文化” 课程设置：伴随着中国的快速崛起，新加坡需要培养一批精通双语、学贯中西，“能够同中国人在同一个思想频道上沟通”的双文化精英，以巩固新加坡作为东西方文化枢纽和商业中心的地位，推动新加坡可持续发展。教育部于2005年正式推出“双文化”直通车课程（中三至中四称“双文化”，高一高二为“中国通识”）。

但“双文化课程”的跨文化的教学特性使其教学一开始就不得不面对这样的巨大挑战：一方面是学生基础薄弱、知识储备不足、语言表达差、思辨能力弱；另一方面却是课程涉及范围广（包括社会与文化、统治与权力、发展与挑战、中国与世界等四大课题），时间跨度大（自1978年改革开放至今）、内容日日新、考试要求高（考核形式分案例分析、综合问答题及独立研习论文三类，实行层级判分）。要打通“双文化”课程与“少教多学”的任督二脉，将其落到实处，就必须以学生为本，围绕学生的“认知能力”与“知识建构”这两个关键词，以学定教，将“双文化”教学打造成一个在教师的组织、导引和帮助下，以学生为主体，通过创设生动活泼的情景，调动多元资源，让学生主动探究，获取、分析和处理信息，形成自己的创造性的探究结果，推动学生全面发展的过程。

（一）“双文化”课程的“少教多学”以学生的认知结构、认知能力为核心

新加坡精英教育体系和“怕输”的社会文化，决定了“少教多学”的立足点在“多学”——充分发挥学生的主体性，开出他们学习的内在积极性和主动性。但传统教学模式重在知识传授，对学生学习能力的培养关注不足。由于学生不会学习，课堂上不能及时吸收，课后难以消化，学习欠债越来越多，学生负担越来越重，教师教得费劲，学生学得吃力。“少教多学”就是试图通过从“以教为中心”到“以学为中心”的教学范式转移，让学生成为学习的主体，教师积极引导学生主动学习和有效学习，提高教学质量与学习效率。

1 李显龙〈国庆群众大会华语演词〉，《联合早报》2004年8月23日。
2 何穆彬〈新加坡“少教多学”改革的实施框架〉，《天津教育》2011年第1期。

学生的学习是对知识或信息进行过滤、记录、存储、提取和重复使用的过程，美国教育心理学家加涅(Robert M.Gagné，1916年8月21日－2002年4月28日)认为提高学习效率、发展自主学习能力的先决条件是学习策略，在学习策略中认知策略处于核心地位，是学习方法的内核[3]。王瑞杰教育部长2013年在新加坡首届"认知科学"研讨会上，也提意推广“认知科学”来提高学生的学习效率[4]。因此“双文化”课程教什么、学什么、如何教、如何学，必须从学生的现有知识水平、学习动机、性格特征、行为习惯及智力发展等多种因素出发，遵循其认知规律，在准确评估学生的策略水平的基础上，以学生的“最近发展区 (Zone of Proximal Development) ”[5]为着眼点搭建学习支架，调动学生的积极性以发挥其潜能。

为此，在“双文化”教学设计中应将“授之以渔”的认识论、方法论放在突出地位：一方面教会学生怎样学习。建议在学生原有学习经验基础上，以工作坊、讲座、智力游戏等形式进行认知策略训练，并通过认知训练与课堂教学相结合来推动策略的尝试、反思、迁移与应用等，使学生将其内化为自己学习策略，实现从“学会”到“会学”再到“乐学”的超越，将“少教多学”落到实处。另一方面教导学生怎样思考。新加坡自1997年提出“思考的学校，学习的民族”(Thinking School, Learning Nation)后，思维训练在教学中扮演着重要角色。

“双文化”课程在“少教多学”的教学实践中，我们倡导通过思维导图（Mind Map）[6]、苏格拉底式问答法等各种喜闻乐见的形式培养学生的发散性思维，同时鼓励逆向思维，角色扮演等形式去做多角度的换位思考，培养学生的批判意识，促进学生思维活动水平及解决问题能力的提高，打造学生思维的流畅性、灵活性和独创性。

另外，“双文化”课程的“少教多学”，要求从学生的认知水平兴趣爱好、便于理解操作的角度出发，在教学实践中应按知识建构规律将所教的知识进行分类，把“高、广、深”的教学期望与学习目标分解为若干个细目，然后选取用讲解、辩论、专题作业[7]等相应的教学方式方法进行教学，融学习方法于知识中，寓学法于教法中，将“教室”变成“学堂”。

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3 E. D. 加涅<教学与学习的有效策略>《外国教育资料》1991第5、6期。
4 陈秋华<王瑞杰：认知科学有助设计更有效学习方法 >,《联合早报》2013年1月5日。
5 关于维果茨基（Lev Vygotsky）“最近发展区”理论，可参看钟启泉《现代教学论发展》（北京：教育科学出版社，1992）页298-314。
6 就思维导图在双文化课程中的运用，可参看拙文<学会用思维导图构思论文>，《华侨中学双文化优秀论文集》（新加坡：华侨中学，2010）页535-546.
7 可参看拙文<“双文化课程”背景下的作业>,《中国教师报》2013年2月27日。

（二）“双文化”课程的“少教多学”是以学生知识建构为核心的探索性学习

建构主义从人类历史的长时段的视角、以人类实践的宽维度为关照，提出了知识和学习的建构性特点，以“情境”、“协作”、“意义建构”为学习要素，揭示了知识生产和学习建构的内在逻辑[8]。建构主义的学习论认为知识的学习是以学生为中心，借助在一定情境下的教师和同伴的帮助，利用必要的学习资料，通过意义建构的方式而获得。它强调学生对知识的主动探索、主动发现和对所学知识意义的主动建构。而互联网的普及，让信息的获得越来越容易，知识更新周期越来越短，学习型社会和终身教育的理念深入人心，为建构主义学习论的风靡全球提供契机。“基于资源的学习”（resource-based learning）成为21世纪建构主义学习实践的主要方式[9]。

在学生以自己的知识及认知结构为基础进行知识建构的过程中，奥苏伯尔（David Ausubel，1918年10月25日—2008年7月9日）指出：“影响学习的最重要的因素是学生已知的内容。”[10] 学习是在原有知识基础上的自我建构与重构，学生原有知识与认知结构在很大程度上决定着知识建构的质量。因此，“双文化”课程“少教多学”应以建构主义学习理论为基础，一方面培养学生养成与时并进的良好学习习惯，另一方面教给学生有效的学习方法和创新思维技能。培养学生关注新闻时事是“双文化课程”的内在所需，因为没有任何课堂能够囊括中国的快速发展和急剧社会变迁；培养学生养成一种自学阅读、探究时事的习惯，也是“少教多学”的客观要求；它更是双文化人才培养的核心理念之一，只有与时并进，才能引领世界潮流，做时代的弄潮儿。为此“双文化”直通车课程鼓励中三到高二的学生将读报和收看（听）新闻日常生活化，创设课堂新闻播报、新闻沙龙等形式进行新闻分享，既将学生的视野引向丰富变幻的世界，也培养起终身学习的好习惯。另外，诚如苹果公司前总裁乔布斯（Steven Paul Jobs，1955年2月24日—2011年10月5日）所言，创造不是才华、潜意识和机会的产物，而是思考的结果，是一系列对于问题和解决方案的重复思考过程[11]。在很大程度上，无论是中四的双文化论文，还是高二的独立研习论文，都是鼓励学生进行创造性的有意义学习（Meaningful learning），论文写作既是学生有效运用知识与认知，去通过主动发现问题、分析问题、解决问题的主动探索的知识建构过程，也是一个在建构中不断批判反省已有的认识与实践，运用批判性思维进行自我调整以丰富完善自身知识结构的探索性学习。而这种探索性学习也应该成为“双文化”课程“少教多学”的基轴。

8 何克抗〈建构主义——革新传统教学的理论基础〉，《学科教育》1998年第3、4、5、6期。另见高文《建构主义教育研究》（北京：教育科学出版社，2008）。
9 丁炜〈基于资源的学习的特征、设计与评价〉，《外国中小学教育》2005年第6期。
10 王惠来〈奥苏伯尔的有意义学习理论对教学的指导意义〉，《天津师范大学学报》2011年第2期。
11 许莹〈乔布斯成功的启示〉，《中国发明与专利》2013年第4期。

（三）双文化“少教多学”强调通过学习共同体，进行合作学习

建构主义视阈下“学会求知” 被视为“21世纪技能”，“教会学生学习”成为现代社会教学的主要任务[12]。“双文化”课程的“少教多学”不是教师给学生灌输知识、技能，而是创设特定的教学情境，让学生通过合作学习或独立学习，驱动自己学习的动力机制积极主动地进行探索性学习。布卢姆（Benjamin Bloom，1913年2月21日－1999年9月13日）就指出：“只要有合适的教学条件，一个人能学会的东西，几乎所有的人都能学会。”[13]

在学生的知识建构中一个不容忽视的内容是问题意识及探究动机的形成。情境认知学习理论（situated cognition and learning theory）认为应通过创设真实的或者模拟的学习环境来提高学习的有效性，实现知识向真实生活的迁移。所以在双文化教学实践中，也应遵从学生的认知规律创设生活情境、社会情境或问题情境，让学生很容易尽快进入课堂。如针对南中国海的领土纠纷，“双文化”课堂教学中就采取角色扮演的方式，同学们分别代表中国、美国、菲律宾、越南及新加坡，通过在模拟联合国大会上辩论，让学生在自身的经验、信念和背景知识的基础上，通过与他人激烈辩论中的心灵合作与智慧碰撞，来开启学生了解南中国海争端的来龙去脉的兴趣，进而认识中国崛起中的机遇与挑战。建构主义强调的协作、会话等学习环境要素，也使学生在教师的组织和引导下通过合作学习共同建立起学习共同体，既可以采用“后茶馆式”[14]课堂质疑讨论，也可以“及时教学(Just-in-Time Teaching)”式的网络互动[15]等形式，不拘一格，通过学习中的互助合作，使学习因互动而精彩，学生因自主而发展，不仅增强学生的学习效果，而且培养他们的团队精神，推动“全人教育”。

（四）双文化“少教多学”要求教师备学生、备内容、备教师。

“双文化”课程的“少教多学”尽管强调学生在教学中的主体性，但并不忽略老师在知识建构进程中的主导地位。学生主动研究性学习是“少教多学”的关键，教师的顺学而导是“少教多学”的桥梁。教师在学生探索性学习进程中总揽全局，通过与学生的交互、参与、反馈、帮助和调适，扮演建构知识的参谋顾问、建构伙伴、组织导演、评估裁判等多元角色，使学习成为师生间、学生间多向互动的知识、信息沟通与加工的过程。因此，老师在

12 陈能端<信息和通信技术融入教学，21世纪技能助小学生当“全人” >，《联合早报》2012年8月15日。
13 张春玲<对布卢姆掌握学习理论的再认识>,《洛阳师范学院学报》2001年第1期。
14 张人礼<后“茶馆式”教学>,《上海教学》2010年第1期。
15 刘粤湘、夏玉秀<及时教学法:一种现代教学方式及高校教学改革示范>,《中国地质教育》2006年第3期。

“少教多学”的作用不仅没有降低，反而愈加教师充分发挥主导性，任务更重，责任更大。

一要“备学生”：建构主义重视个体的自我发展，“少教多学”要求教师在教学设计、组织、评估活动中着眼于“以学生为本”，着力于对学生内在学习动力的激发。“双文化”的教学策略必须服务于学生的学习发展，只有敏锐、全方位了解了学生，对不同学生的知识结构、思维特点、情感指数等差异及发展需求成竹在胸，才能准确把握其学习的盲点、难点、重点，正确设计教学的难易深浅，因材施教，通过深奥的理论浅显化、抽象知识具体化，及时激活学生相关的原有知识，把新旧知识联系起来，异中求同，同中求异，引导学生得出新知，并自觉主动地把众多的知识点串成线、结成网、叠成块，构建四通八达的知识网络结构。另外，学生的起点决定教学的路径，只有对学生了解得越透彻，设计教学过程及方法才会越有针对性地实施差异教学，以学情定教学目标，以学情定作业，以学情定考核，才能更好唤醒学习的成就感，调动起学习兴趣，培养学习积极性和创造性，通过比较、联想、假设等手段吸引他们不仅自觉参与到教学中来掌握新知识，而且启迪他们学以致用，去发现、探究、解决新问题，成为“学习的主体”。

二要“备内容”：“少教多学”强调“以学定教”，要求教师在精心洞悉学生认知的基础上，对课程内容融汇贯通科学编排，筛选合适方法安排教学活动，对教学评估一目了然。学的终点决定教的深度和广度，客观上要求老师认真研读教育部《课程内容指引》，准确理解编者意图，站在双文化人才培养的高度吃透考评局的《考试纲要》。“少教多学”　中要实现“少”而“精”，严重挑战老师的知识与智慧，只有通过博学、审问、慎思、明辨，苦练内功，提升自己对中国发展变迁的敏锐感和洞察力，熟稔课程内容，才能高屋建瓴，启发点拨学生乐学善用。“少教多学”　中“备内容”还应包括从学生认知的角度安排教法，一方面抓住课程的核心内容，深入挖掘并准确把握当代中国社会发展变迁中的热点难点，以增强对学生的吸引力；另一方面在课堂呈现上下功夫，以学生喜闻乐见的知识传授方式让学生容易学、喜欢学，使知识“实”、思路“清”、方法“活”，让学生在教师的引导启发下，对当代中国的发展转型做深入及有意义的思考，把教学知识结构创造性地转化为学生的认知结构，让“多学”更富效率。

三要“备老师”　。“少教多学”学在教前，教为学服务，以教引学，教学相长，这就要求教师应该充分地研究自己，不仅需找出与学生的内在联系，而且也要发现自己的优点与不足。当今信息时代的认知方式正从个体认知转变为分布式认知（Distributed Cognition），为此2008年新加坡公布第三个教育资讯科技总蓝图（IT Masterplan，简称mp3）[16]，强调通过有效使用资讯通信

16 王珏琪<mp3总蓝图助师生运用IT科技>,《联合早报》2008年8月6日。另见黄利发<新加坡华文教学跨越式发展创新试验研究>，《中国电化教育》2011年第7期。

科技，创设信息化的教学环境，搭建情境创设、启发思考、信息获取、资源共享、多重交互、自主探究、协作学习等多元网络信息平台，促使“双文化”课程的“少教多学”正逐渐跨越课堂与课下、中国与世界的畛域，走向汇通。以快速崛起的中国作为教学内容的“双文化”课程教学必须与时并进。在同步进行的教师的教学活动与学习者的学习活动中，老师不仅把授课内容、学生作为自己研究和认知的对象，也应通过课例研究（Lesson Study）[17]等方式理性思审视自己的教学行为和过程；不仅将自己的学术专业知识转化为教师的学科教学知识，更应该将其转化为学生的知识建构与探究学习的能力，在批判中创新，在创新中发展。

“双文化课程”贵“通”，讲求知识与能力、过程与方法、情感与价值的三维培养。“少教多学”强调以学生学习的主体性为依归，是立足于新加坡学生认知特征及知识建构内在逻辑的教学范式转型，其对“双文化”教学的深远意义或许不是“多”与“少”的教学数量颠倒，而更在于是“教”与“学”的置换中的能力素质提升。开出学生的主体性，使其自觉从寻找答案转向对问题的探索，正是培养创新型双文化精英的玄机所在。

17 相关研究见Stigler J W, Hiebert J. *The teaching gap: Best ideas from the world's teachers for improving education in the classroom* . New York: The Free Press, 1999. Triwaranyu C. Models and strategies for initial implementation of lesson study in schools. *International Forum of Teaching and Studies*, 2007(3):48,15

International Collaborative Lessons: a case study in gaining cultural perspective

Menlo School – Peter Brown, Global Programs and Studies Coordinator

As interest and capacity in instructional technology and global education continues to grow, global educators have new opportunities to connect students from different cultures, countries, and continents through the development of collaborative lessons using technological interfaces and blended learning. These collaborations typically involve administrators or teachers in schools in different countries planning lessons and units together and then connecting their students across national borders through curricular-directed conversation and projects. Leveraging diverse cultural or regional characteristics, international collaborative lessons offer the potential for teachers not only to deepen their students' content knowledge but also to expand their students' cultural awareness, sense of perspective, and circle of friendships.

This article focuses on one international collaborative project involving two SAGE member schools, my social science class of seventeen students from Menlo School, in Atherton, CA, USA, and two social science classes at the Dalton Academy division of the High School Affiliated with Peking University, in Beijing, China (hereafter abbreviated as PKU-Dalton). The students in both institutions are 17 or 18 years of age.

The collaboration began as a conversation last June between myself and Jared Hall, PKU-Dalton's Curricular Programs Coordinator and History Teacher. We both wanted to explore the ways students saw their country's politics and culture and the different ways that history might be written or taught in different countries (an idea another colleague at Menlo is developing with Perse School, UK, another SAGE partner). Employing Schoology, a Facebook-like platform designed for schools, we arranged our classes so that each partner school would have roughly equal numbers of participants, and then we divided our students into smaller groups to maximize their opportunities for meaningful interactions. We planned three interactive, asynchronous iterations over the course of a week. First, we had each group post and share videos introducing themselves and their schools to their cohort in the other school to allow the students to get to know one another and to familiarize themselves with the Schoology platform. Students also posted responses to the other group's videos, "liking" them, etc. The second interactive lesson had students finding and posting sample texts from academic sources that addressed events in US or Chinese history or US-China relations. Students uploaded these texts along with summaries, analyses, and questions for the cohort in the other school. For instance, after posting, summarizing, and analyzing a US History text addressing the Chinese-Exclusion Act of 1882, the American students might ask their Chinese cohort: *Have you learned of this event in your school? If so, how is the text similar to or different from the perspective presented here? Is there an equivalent issue involving immigration in Chinese history?* The third iteration of our international collaborative learning exercise was the least structured, a consideration of a single question: *What –ism (or political concept) best describes your*

country? For this assignment, unlike the second, no model was provided for the students, and no texts were required. The third iteration was intended to engage our students in a general conversation around broader topics of politics, culture, and society.

We completed our international collaborative project exactly a week ago as of this writing, and Jared Hall and I briefly shared our perceptions. While a fuller debrief is in order, the writing of the Menlo and PKU-Dalton students reflects their gains in perspective, their surprise, and the need for further collaboration and investigation. For instance, given the current tension and debate in the US over the recent American government shutdown, some Menlo students were surprised to read from their PKU-Dalton cohort that the Chinese government will never shut down because of the nature of one-party rule. In another common example, several Menlo students wrote of their PKU-Dalton cohorts' citing of the rise of individualism in China. Given that the Menlo students had been studying the communist revolution in China and the ethics of socialism and communism, they were surprised to read about this. In some cases, due to the helpful intervention of their PKU-Dalton peers, Menlo students drew connections between the rising ethic of individualism and selfishness and China's one-child policy. Another Menlo student cited the different tenor of debate about abortion in China, which is a perennial and seemingly intractable issue In the United States. One PKU-Dalton cohort member wrote that the perspective in China, in contrast, is that abortion is a way to enforce restriction on unwanted population growth. The PKU-Dalton students were somewhat surprised to learn that the Menlo students believed that the US government had been acting in the interest of China in enforcing the Open Door policy of 1899-1900. The PKU-Dalton students wrote that from their perspective this was an imperial venture, serving the interests of American merchants.

The most common insight from Menlo students was the degree of *similarity* they observed between themselves and their Chinese cohort, but this was not always something to celebrate: one Menlo student observed that both sets of students felt pressure to buy the most expensive clothes, etc., because that is part of the equation for making and keeping friends. Curiously, the general sense of the PKU-Dalton students was that the Menlo students had a fundamentally different worldview than their own. This was one of several interesting inconsistencies and questions that the project raised.

There were other limitations to this project, too. Aside from time restraints and a few minor technological challenges regarding the platform, the group interactions themselves raised potentials for misinformation

and misinterpretation. It was easy, for instance, for students to regard their cohort in the other country as necessarily expert on complex questions and easy to assume that the answers of a few students in the other country necessarily spoke for the entire country or generation. Responses based on different expectations of politeness, restraint, or other cultural codes and norms for discussing certain subjects were also apt to be misconstrued. Finally, the observations above are preliminary: a fuller debrief, including more PKU-Dalton Academy students' findings, would bring more conclusive results. Nevertheless, the project seemed well worth the effort in terms of the learning and perspectives gained and the enjoyment: PKU-Dalton and Menlo students universally enjoyed the experience. Finally, the inconsistencies and limitations of the project can be viewed as helpful: invitations for further teaching, learning, collaboration and research.

So what conclusions might be drawn from this brief case study? Three tentative ones come to mind. First, if our role as global educators is to deepen our students' sense of perspective and knowledge about the world, international collaborative lessons seem to offer a viable method for doing so. Second, if global educators working in resource-constrained environments seek means to connect their students across borders, the international collaborative lesson offers a relatively cost-effective way of doing so. Third, if global educators aim to involve their fellow teachers in the global education initiatives and opportunities for professional development and growth, the international collaborative lesson might serve as a powerful medium.

These ideas are briefly elaborated below.

While the case study described above emphasized the role of international collaborative lessons in cultivating knowledge of diverse perspectives, lessons involving data collection and analysis, such as the kind that typically occur in science classes, also seem well suited to international collaboration. In a project between Menlo's seventh grade science teacher and a colleague at Tsai Hsing School in Taiwan, for instance, students conducted experiments on their local environments, collecting, sharing, and analyzing samples of earth for forms of life and engaging in conversations about the reasons for similarities and differences. In another project, involving a collaboration between a ninth grade science teacher at SAGE partner Nanyang Girls' High School in Singapore and a Menlo ninth grade science teacher, students recreated Aristophanes's experiment measuring the circumference of the earth. The international collaborative lesson has long been used for the practice of foreign language development through the cultivation of pen pal relationships and the like. Menlo's Mandarin Chinese teacher has been involved in several projects that enrich and enliven her students'

language learning through international collaborative lessons, including a project on the analysis of idioms. In sum, it appears that lessons or units that stand to be enriched through the inclusion of multiple perspectives, diverse data samples, and the practice of language are good candidates for international collaborations.

Assuming that collaborating institutions have readily available technology and connectivity, as is the case with both PKU- Dalton and Menlo, international collaborative lessons seem to incur little extra technology costs (e.g., in our collaboration the Schoology platform was freely available). The greatest cost might well be the time and support needed for partners in different schools to plan projects together, particularly if the planning involves travel to distant schools. In some institutions with a tradition of teacher autonomy (e.g., American independent schools), collaborative lesson planning is a challenge to undertake even within the same department and school let alone across borders, time zones, languages, schedules, contexts, etc. Direct contact between collaborators or collaborating teams, then, might make these kinds of lessons more feasible to plan and undertake, at least initially.

International collaborative lessons, finally, offers teachers ways to enliven their classes, make them more relevant, while adopting appropriate technologies and meeting colleagues from across the world. Just as Jared Hall's and my classes were mutually enriched, enlivened, and helpfully complicated by our collaboration, an experiment on fauna and flora in a science classroom might be similarly enriched by comparing data samples and analyses from students in another region of the world; language teachers know that their lessons can be enhanced through online conversations with native speakers. International collaborative lessons, therefore, can enliven a traditional classroom. At the same time they preserve the teacher's centrality to the learning enterprise.

International collaborative lessons also might play a role in a teacher's professional development. Certainly, a teacher needs to have or gain some facility with technologies that are constantly changing and upgrading. The greater challenge, however, is the broader pedagogical one of finding and implementing mutually beneficial curricula between partners in different parts of the world. The process of developing international collaborative curricula provides a potential means of pedagogical development that could benefit teachers professionally while advancing the values of a globalized curriculum. It also offers teachers, as well as their students, the opportunity to broaden their circle of acquaintances and friends across borders.

At Menlo School we are at the early stages of developing international collaborative lessons, but despite occasional missteps we have found them to offer an interesting and potentially rich vein of opportunity to advance our students' learning. Thus, in the past year we have tripled the number of our international curricular projects and are involving a significant percentage of our student body in these kinds of endeavors. We hope in the future to improve on the lessons we've tried, to build further on those experiences, and to learn from the experiences and lessons of other schools doing this work. We are grateful to the SAGE consortium and each of our SAGE collaborators to date: PKU-Dalton Academy, Nanyang Girls High School, and the Perse School. We look forward to continued development of established projects and to developing new ones, as well.

南洋女子中學校
Nanyang Girls' High School

Taman Negara Sabbaticals – Reconnecting the Disconnected

Nanyang Girls' High School – Ms Vanessa Tsang, Experiential Learning Specialist

"It takes time—loose, unstructured dreamtime—to experience nature in a meaningful way." Richard Louv, Last Child In The Woods

Singapore Childhood – Our Stories Then and Now, authored by Jamie Koh and the Singapore Children's Society is dotted with childhood stories by people who once lived in the kampongs (wooden or attap houses). Their stories speak of days when "playgrounds" were simply defined as any open space for play, devoid of manicured parks with state-of-the-art playground features and rubber mats.

These changed with the exodus from kampongs to flats in the 1970s. Nature had to give way to urbanization and flats took the place of idyllic settings where kampongs once stood. With the changing landscape, outdoor spaces became increasingly scarce.

While some children never stopped engaging in the outdoors through innovative means such as catching fishes in large canals and drains, much of play has since been confined to corridors and void decks.

Although play retreated to a seemingly safe haven, it was found that even playing in such places was met with much caution and skepticism from the older generation. As pointed by an interviewee, "Even though there was a corridor, every household had their doors closed. "We didn't even really know who our neighbours were," recounted Alvin's sister. "My mother did not want us to play outside – she said it was dangerous – so we stayed indoors, played by ourselves or read."" (Koh J., 2013 pg 98)

This phenomenon is similarly reflected in the UK. George Monbiot wrote of "…several reasons for this collapse: parents' irrational fear of strangers and rational fear of traffic, the destruction of the fortifying commons where previous generations played, the quality of indoor entertainment, the structuring of children's time, the criminalisation of natural play." (Monbiot G., 2012)

With the demise of outdoor play and spaces, it is no wonder that our children have little choice but to turn to indoor play – one that breams with "smart" devices and screens offering a parallel virtual existence that exerts a powerful grip on their psyche. It is thus fairly common to observe children whipping out their devices wherever there are pockets of time instead of engaging with the people around them. It takes only

a cursory glance to realise that human beings are indeed becoming increasingly connected virtually but virtually disconnected from experiencing the real world, especially the great outdoors.

In a nod to Monbiot's sentiment that humans will not fight for nature unless they have spent a considerable length of time immersed in it, the Nanyang Experiential Learning team designed and led overseas programmes with the aims of reconnecting the disconnected. One of such trips was to Taman Negara National Park, located in the north of Malaysia, in 2012 and 2013.

For genuine appreciation and love for nature to develop, it is insufficient to merely have an experience with it but the experience has to be a positive and meaningful one. Thus the programme had to possess certain key features. Firstly, it had to be a programme which undertakes a slower pace to provide the time and space to enjoy the element. Secondly, the programme has to positively engage the different senses and finally, it has to provide the space for self-reflection. The applications of these features are further explained in the following paragraphs.

The sabbatical was planned such that it encompassed a maximum of two activities each day. For example, one of the afternoons was spent in the river. Its objective was play. During our river time, the students simply floated downstream, a novelty which all of them had never experienced before. We played ball games and skipped rocks. These simple activities, which were probably taken for granted in the past, were very much relished by the students. Time was not of the essence – they were given the time to fully immerse themselves in the element and enjoy it in all its glory.

Another afternoon was spent on an easy trek to the canopy walk, which allowed them to view the forest from a different perspective. They were encouraged to touch and feel the trees and leaves as they proceeded along the boardwalk and appreciate the magnificence of the forest.

Night walk was intentionally put in place to further engage their senses. Silence had to be observed, all chatter had to cease and they could only rely on their hearing and sight as they trekked in the night to spot wildlife. Nature rewarded the students with sightings of various nocturnal bugs and insects, with animals such as tapirs, samba deer and even a flying lemur being the guest stars of the night. The fascination and satisfaction of spotting these in the wild were indeed indescribable.

In many different experiences, consolidation of thoughts and reflection of their personal experiences in the form of solo time are essential to crystallize their learnings. Being in a natural setting, reflections were often done in the outdoors with inspiring views of the forest in a tree hut and some days, along the bank of the river. The only sounds that they heard were those made by the cicadas, crickets, chirping of birds and the rush of the river. This is truly the symphony of nature. These inestimable moments provided an avenue for the students to capture and immortalize the learnings they had gathered from their personal experiences and senses.

If nature is to have any hope at all in the distant future, the change has to begin with the education of this generation. As Monbiot rightly pointed out, "Most of those I know who fight for nature are people who spent their childhoods immersed in it. Without a feel for the texture and function of the natural world, without an intensity of engagement almost impossible in the absence of early experience, people will not devote their lives to its protection." (Monbiot G., 2012)

People will not fight for something that they have no attachment or connection with. Where humans were once part of nature, we are now living increasingly apart from it. Through this sabbatical, we hope to have brought about the realisation that humans are still intricately connected with nature. We need to reconnect with the once-connected.

References

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Monbiot G. (2012), If Children Lose Contact With Nature They Won't Fight For It. Retrieved on 22 October 2013, from http://www.theguardian.com/commentisfree/2012/nov/19/children-lose-contact-with-nature

Reflections from students

"The main highlight of the trip was probably the river activities. Maybe because I love water, but for the first time I felt the soul of the river. Sounds weird but that's how I feel. I guess then you can say that we have truly connected with nature, for a moment felt like we are part of the big ecosystem in Taman Negara."

"I eventually realize that Taman Negara gave me a whole new experience of learning and appreciating nature on an entirely different level! The entire trip was just so filled with close-up moments of lush forest, freshwater rivers, cool animals and even many types of insects / bugs that I have never seen before. However, this trip really gave me the opportunity to see how beautiful nature was, especially through all the fun-filled activities that were lined up for us, such as the biodiversity survey. The night walk, playing in the river and skipping stones and finally, staying in a hide in the middle of a forest for the very first time. All these were extremely memorable to me."

南洋女子中學校
Nanyang Girls' High School

A Case Study: iPads in Science Lessons

Nanyang Girls' High School – Mr Mark Shone, Subject Head Relations & Communications and Mr John Lee, Biology Teacher

This article shares many of the creative and innovative ways Nanyang Girls' High School has been using iPads in science lessons and shares two case studies of use of the iPad in science lessons.

Introduction

When Apple chose to launch the latest version of the iPad on 22 October 2013 they played a short video highlighting the many ways in which the device has changed many areas of life. Of course, one area that was highlighted was education. Of the thousands of schools now using the iPad throughout the world they chose a science lesson at Nanyang Girls' High School to showcase the best practice use of iPad in an educational environment.

Nanyang Girls' High School (NYGH) was a pioneer school in terms of the adoption of the iPad as a technological device to be used in the classroom. Within a few months of the release of the original iPad teachers at the school could see the potential of the device and began assessing the possible impact in the classroom if it were to be adopted in the school as a 1-1 computing device.

NYGH made the bold decision in late 2010 to become one of the first schools worldwide to adopt the iPad as the as the technology choice in the classroom. The go-ahead was given for the pilot project and by January 2011 four 1-1 iPad classes were started.

The success of these classes was followed by roll-outs to further levels over the following years and by January 2014 there will be more than 1200 of our students using the iPad as their personal 1-to-1 device in the classroom.

Connecting to the World

It is unavoidable that science lessons are very content heavy and science has a tendency to be a rather dry subject. Teachers realised very early that the iPads helped to break down the walls of the classroom and expose the students to real world examples. The students get to see that science is not just something that happens in textbooks and school labs but is a very real part of the world they live in. Having access to the Internet meant that students could easily and conveniently access many online resources and find information quickly. It also meant that materials such as YouTube video clips could be used to engage the attention of students and

made a useful way of grabbing the attention of the students at the beginning of the lesson to get them to think and to bring relevant learning experiences to science lessons.

For example in 2011 when the nuclear disaster struck Fukushima, Japan, there was widespread coverage across the news and teachers were able to bring this news story into the classroom. They used it to explain how a nuclear reactor works, the dangers of nuclear power, start a conversation about where our energy comes from, renewable energy resources and so forth.

Other news stories that we would bring up included the latest discoveries at the large Hadron Collider, the latest NASA space mission, discussions on Nobel Prize winners or research in lifesciences or nanotechnology. Certainly these are topics that are not in the traditional syllabus but all bring some currency to the subject and reinforce the idea that the sciences are relevant subjects for the world we are living in.

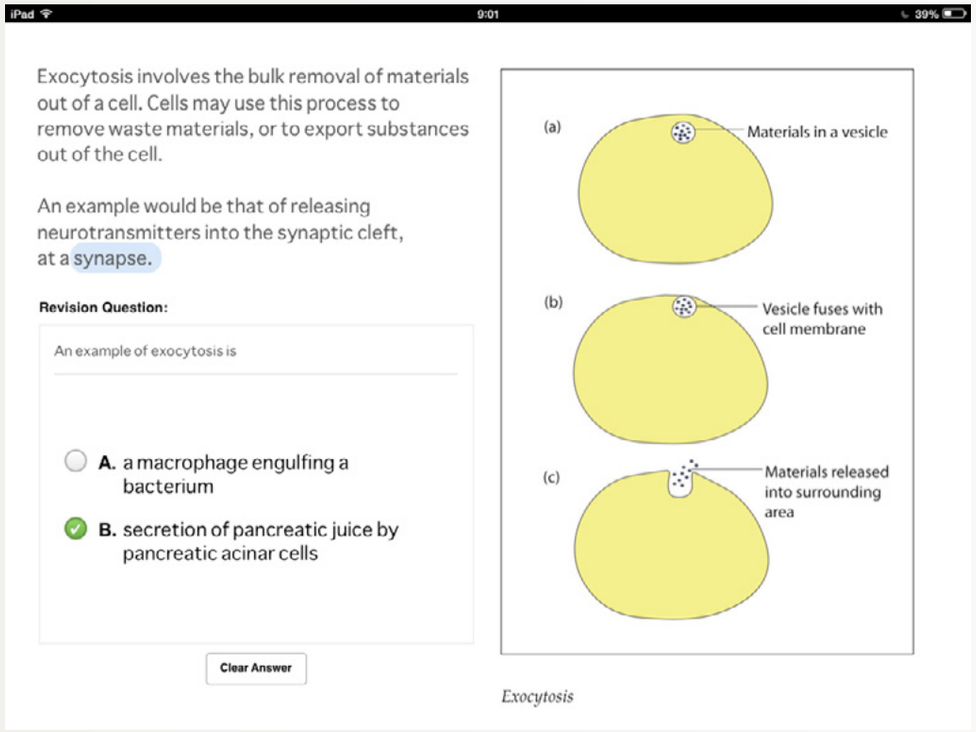
Notes and Textbooks

The level at which we teach students frequently goes beyond what can be found in the textbook both in terms of subject matter covered and the depth of study. Subsequently, teachers frequently provide the science students with additional notes. This used to result in massive quantities of photocopies being passed to the students. Today it is seldom necessary to give hardcopies and instead PDF files have become the norm.

Several of us have dabbled with creating our own iBooks too. iBooks are easily created on Apple computers running the (free) iBook Author software. The advantages of iBooks over a PDF set of notes are numerous and include the ability to incorporate video, audio and interactive elements.

To ensure that we are not infringing copyright materials we ensure that we only use our own photographs or diagrams we have drawn ourselves. Although this was time consuming at first many of the teachers found it rewarding and quickly became very proficient using Adobe Illustrator or the drawing tools in Microsoft Word.

One step beyond just creating iBooks is the use of iTunesU. This is Apple's portal for iOS devices that allows for the gathering of teaching materials into one online space that works seamlessly with the iPad. The advantages



Teacher-created Biology iBook

for students are that the materials are pushed onto their devices, they can access the material when off-line and notes and comments made by them will sync between all of their devices.

We are of course keen to replace hardcopy textbooks with electronic soft-copies, however we are still waiting for most of our textbook publishers to produce the electronic versions. This is happening, but slowly. It will probably be many more years before all of the textbooks we wish the students to buy are obtainable on the iPad.

In the Classroom

Although we certainly do make use of some science apps, we are probably not using these as frequently as we had initially imagined. Many apps are generally designed to do one thing which makes their use rather limiting and will resign them to maybe a demo from the teachers iPad rather than classwide installation on the students' iPads.

Many science widgets are still not ported to the iPad, though this is continuing to change and more and more such interactive materials are now being created in iPad friendly HTML5 or in their own apps.

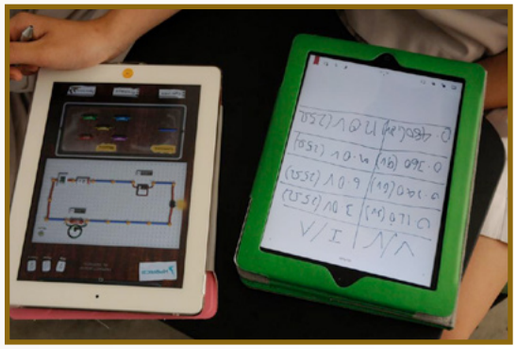
We have been hesitant to ask students to buy many apps as we find there is nearly always an equivalent app available for free. The only apps that we really requested students to purchase were the apps for creation of

Materials on the Device such as Apple's Pages, Numbers, Keynote and iMovie - interestingly these have all recently been made free.

Keynote has been one of the more widely used apps in science lessons. Designed purely as a presentation tool it is of course used by both teachers and students for presenting to the class. However, we have discovered that this app is a lot more flexible and a Keynote file can do a lot more than just make a great way of passing notes to students. Students can have a copy of the notes that the teacher is using for presentation and of course modify, add to it and make it their own. Keynote slides can have missing words or unlabelled diagrams and the document becomes a worksheet for the students to fill in the blanks or label the diagram. Additionally the ease with which objects can be animated in Keynote gives a great way for students to create simple animations to show actions or processes in action.

With the move to a 21st century learning environment we are always encouraging students to work together more frequently. Collaborations can often be virtual with many apps supporting multiple users contributing simultaneously. For example Google Drive documents allow for students to be simultaneously working on different parts of a science report. Project data from different pupils can be entered onto a shared spreadsheet to allow for comparison of different sets of results or to build a larger data set for analysis.

Many teachers have set up areas on the web that students can not only access to get additional materials but are also able to communicate in. We have explored using different types of sites and have realised the differences and potential each has to offer. Wikis offer great flexibility, Google sites offer ease of set-up and powerful control of who can access the materials posted there, whilst Edmodo has a facebook-like feel that the students are comfortable with and intuitively know how to use.



Recording results of virtual experiments

Familiarity with using the iPad in the class and the creativity of our forward-thinking teachers led us to try something different - flipping the classroom. A 'flipped classroom' is where the student does some learning outside of the traditional classroom (usually at home) and then will do an activity or assignment in class. The advantages to this include the fact that the teacher spends less time lecturing to the class and more time

facilitating learning and helping students individually. Also, materials put up online are there for the students to use again, so a weaker student may be able to view material multiple times if they do not understand on first viewing or maybe sometime later when studying for a quiz or exam. Teachers have used a wide range of apps for creating Flip-classroom material but frequently would be done completely on the iPad itself using apps such as Whiteboard, Explain Everything or iMovie.

In the Lab

Flipped classroom teaching works especially well for laboratory sessions. Where a teacher traditionally had to spend the first five or ten minutes of a lab session explaining how the apparatus works or the dangers and precautions to be taken, the students now enter the lab already having watched this briefing and thus are able to spend additional time hands-on with the apparatus.

Conducting an experiment will require the recording of results. Traditionally this has been in the form of a written table of data. The camera allows documentation of experiments in an entirely new way. We can now ask students to photograph or video the results of an experiment. Such clips can then be used by the students to explain a phenomena - a much higher level of thinking is required for such a task rather than simply recording readings.

Using the iPad camera to record results of an experiment

Out of the Classroom:

Of course experiments do not have to be conducted in the science labs and the iPad has helped us move out of the classroom more.

The following two case studies give a couple of examples of the iPads being used creatively outside of the traditional classroom and lab setting.

Case Study 1:

NYGH Students 'Test Drive' A Field App Using iPads

Plants@NP App: Making Learning Real

A NYGH student comes across a species of mangrove tree at Sungei Buloh and needs further information on its identity, care and propagation methods. She launches the *Plants@NP* app, scrolls through the plant categories, queries the networked plant database to find all the updated information. A great example of real-time performance support, in-context, just-in-time learning! Beyond just passive acquisition of information, the student is also able to be an active constructor of knowledge whereby she records and shares her personal reflections on the mangrove tree's propagation via unique seed dispersal methods within a community of like-minded participants.

Plants@NP (Ngee Ann Polytechnic) is one of the key custom iOS apps developed by iMedia Services - a plant directory-cum-micro blogging app that combines a desktop wiki environment with a companion mobile app.

Ngee Ann Polytechnic previously piloted the use of PDAs (iPhones) for location-based content delivery via HP's MediaScape Authoring Toolkit in 2008, following the adoption of Clementi Woods Park as a learning park. Going beyond mere content delivery and access, this latest iteration of the project incorporates features that empower students to collect, organise, and curate plant data in authentic learning contexts. Through using the app, the field work experience of students from the Diploma in Landscape Design & Horticulture are enhanced and enriched, whereby they can contribute and refer to the plant directory and update it while on the go, on location in a park or nature environment.

In terms of pedagogical value, the hyper-mobility afforded by the iPhone/iPod Touch offers rich potential to embed context in learning, whereby students don't just merely consume, but are engaged as co-creators of plant information in authentic contexts, collectively building and peer-reviewing contributions.

Using iPads in the field

Networking was established between NYGH and the School of Life Sciences and Chemical Technology during ExCEL Fest 2011 and discussions took place to look into the added advantage of using iPads and the *Plants@NP* app out in the field. This collaboration was due to the fact that NYGH was running a pilot project with students using iPads actively as a learning device in class. There was also interest in this collaboration so as to explore the feasibility of using iPads for learning out in field conditions.

Nine students of one of the pilot classes were involved in groups of three to gather data on plant species from an allocated zone at Sungei Buloh Wetlands Reserve. Each group was tasked to gather information and data of mangrove tree species along a line transect of 15 metres off an area of the boardwalk route towards the waterline of the coast. All entries were submitted to the *Plants@NP* database, peer reviewed and fine-tuned by group members. Student researchers were also able to collate and present the data collected (using the *Numbers* app and a generic graphing app) to illustrate the state of biodiversity and any significant human impact of the boardwalk activities on the mangrove trees in that region.

Through this learner-centered activity of learning through exploration, collaboration and reflection, students are engaged with plant taxonomy and identification in a way that transforms their interactions and modes of exploration, thus deliving a richer learning experience overall. Above all, students have developed a deeper understanding of the basis of classification of plant groups and the association of species in natural vegetation based on features of flowers, fruits and leaves used for taxonomic purposes.

Case Study 2:

Rocket Science

For homework a student uses the iPad to access the class' Physics Edmodo page and download the materials for the lesson. She reads this before coming to class and so has a good understanding of the lesson before it begins.

The lesson is conducted in the school field and involves launching water rockets to investigate the forces acting on the rocket and Newton's Laws of Motion.

Using the built in sensors of the iPad with the App 'Clinometer HD', the students are able to measure the angle of inclination of the rocket launchpad.

Measuring the launch angle

Launching the rocket

Students use the iPad to take photographs and videos of the whole process as a way of document the experiment.

Videos of the rocket flight are opened in the motion analysis app *Vernier Video Physics*. This app allows the students to mark the position of the rocket on each frame of the video. The app then creates distance-time and velocity-time graphs of the motion.

The students then create a presentation using Apple's *Keynote* app. This would involve putting together the images, videos and graphs that they had obtained, summarising their findings of the day and answering the questions that were posed in the worksheet.

All of the presentations would be uploaded to the Edmodo website so that students could view all of their peers work. Selected groups would also be asked to connect their iPads to the projectors and present to the class.

南洋女子中學校
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The Humanities Programme at NYGH

Nanyang Girls' High School – Miss Sarah Birchwood, English Teacher

"The Humanities provide multiple lenses to help students understand our world. They equip students with critical thinking and communication skills as well as global perspectives to become confident persons, active contributors and concerned citizens. Indeed, these skills are crucial in enabling our students to navigate the complexities of a rapidly changing world."

— Mr Heng Swee Keat, Minister for Education, 30 May 2012

Harnessing Talents

The Humanities Programme (HP) is a flagship programme under the umbrella of the Nanyang Talent Development Programme (3R+). This well-established and highly popular programme seeks to leverage on both students' interest and talent in the Humanities and offers a specialized platform for students to optimize their capabilities. These students are specially selected at Upper Secondary and given further opportunities to develop and grow their potential through the following key features:

1. A customized curriculum in key humanities subjects: Advanced Literature (HP), Advanced History/ Advanced Geography.
2. Specially designed Philosophical Inquiry lessons every two weeks designed to compliment other disciplines such as Language Arts.
3. Differentiation and acceleration to cater to the needs to high ability students.
4. An emphasis on research, subject mastery, critical thinking, comparative tasks and higher order thinking skills.
   - Opportunities to take part in enrichment activities such as the Moot Parliament Programme and GEB Literature Seminar.
   - Preparation for the Humanities Programme at Hwa Chong Institution.
   - A strong foundation for H3 Humanities at GCE A-Level.

Framed around Essential Questions the specially tailored curriculum allows for refined differentiation and a nuanced application of curriculum and assessment designed to inspire, challenge and enable at every stage of development. As students progress through Upper Secondary, the programme seeks to harness and nurture independent learners, developing their talents beyond higher-order thinking skills and subject mastery to the application of learning, both intellectual and emotional, to become agents of change within Singapore and beyond.

SAGE 联盟

'Throughout my four years in Nanyang, I have realized that I really enjoy the Humanities, as it allows me to think creatively and critically as well as to reason. I also feel that the environment in HP has been very conducive for me, with the smaller class size and vibrant learning environment.'

— Kang Shiyue, Nanyang Girls' High School HP

Inception of the Programme

The programme was implemented in 2008 following a comprehensive needs analysis. In 2007 the English Department Heads conducted a benchmarking exercise across six selective and high-performing schools in Melbourne and Sydney. The report recommendations were reviewed alongside an internal scan of the school's own needs and incorporated into NYGH's four year strategic plan. A key outcome was the creation of a structured Talent Development Programme to facilitate the early identification of talent, attracting students with both aptitude and interest. As such the Literature Mentorship Programme was initiated in 2007, followed by the first cohort of the Humanities Programme in 2008.

Under the leadership of English and Humanities Heads, the teachers deployed to the class comprise those with strong subject knowledge and expertise in their subject fields. Since its inception, the programme has benefited from a unique blend of experience and innovation from both a local and global perspective. The educators have included Senior Teachers, an external Educational Consultant from the United States and an expatriate teacher from the United Kingdom. All HP teachers are trained in teaching gifted learners and have completed the MOE's Foundation Certificate in Gifted Education (FCGE) as a baseline.

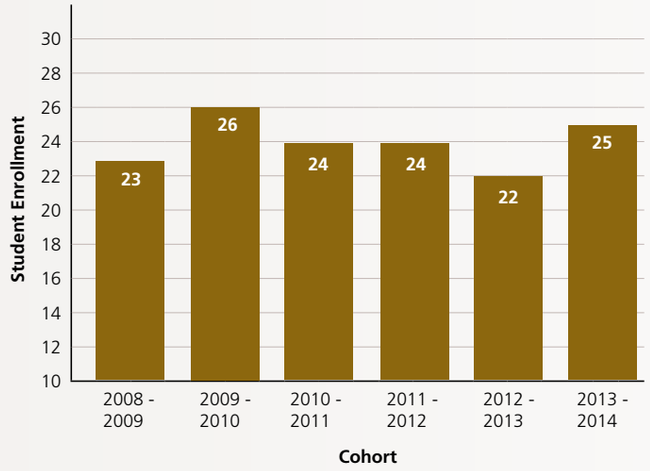
Stringent Selection

Selection for the Humanities Programme class is a thorough and considered process. Students are selected on the basis of academic results, teachers' recommendations and interview. Particular attention is paid to those with strong results in Language Arts and Combined Humanities (History and Geography). The interview stage seeks to identify those with the potential to excel in the humanities subjects and looks for flexible, creative and critical thinking rather than content knowledge. Prior involvement in targeted talent strands such as the Literature Mentorship or the Humanities Programme Class at Secondary Two is also taken into consideration.

Successful students comprise one class of about 25 students and study a differentiated curriculum in the core humanities subjects. Alongside the curriculum, the assessment is also differentiated. For example, Advanced Literature examination questions are comparative across literary genres. Students also study a maximum of two science subjects, alongside Mathematics and Chinese. Thus, opting for the Humanities Programme does not preclude the possibility of studying sciences at Junior College. In this way, the school seeks to give students as much flexibility as possible whilst remaining true to the goals and objectives of the programme.

'What I find the most attractive about HP is the learning environment. I think that learning with a group of like-minded peers creates an environment that in which thoughts and opinions can be raised and freely discussed.'

— Jordan Ong, NYGH HP 2012-13



NYGH Humanities Programme Annual Intake

Key Performance Indicators

The Nanyang Humanities Programme has a strong track record of achievement and our Humanities Programme alumni have gone on to success in many fields.

	2008	2009	2010	2011	2012
MOE Humanities Programme Scholarships Total Awarded	8	9	17	10	17
MOE Humanities Programme Scholarships NYGH HP Students	N/A	N/A	12	9	13

MOE Humanities Programme Scholarships (Pre-U) Awarded 2008-2012

Beyond MOE scholarships, our Humanities Programme students have also performed well in external competitions at Upper Secondary such as the Commonwealth Essay Competition, the UNSW International Competition and Assessment for Schools (English) and at the annual Gifted Education Branch Literature Seminar.

Ng Xin, Humanities Programme 2012-13.

Medal Winner, UNSW International Competition Assessment for Schools (English)

'The past two years in Nanyang HP have given me many unforgettable learning experiences that have given me the conviction to pursue the humanities as a vocation. After two years I have come to appreciate the beauty and significance of the humanities.'

— Teo Min Ru, NYGH HP 2012-13

A mid-term key indicator has been the consistently strong performance of Humanities Programme students in university entrance and scholarship applications including Public Service Commission Scholarships in Economics, PPE and Law and the President's Scholarship 2012. Furthermore, our Humanities Programme alumni regularly gain entrance to top universities worldwide including Oxford, Cambridge, Yale and Princeton.

Dileen Ee
(NYGH Humanities Programme 2008-09)

Dileen is currently reading Economics at Princeton University on a Public Service Commission Overseas Merit Scholarship.

Alicia Tee, President's Scholar 2012
(2008 – 2009 NYGH Humanities Programme)

The President's Scholarship is the most prestigious scholarship awarded in Singapore. As a member of the Humanities Programme and President of the Student Council, Alicia demonstrated outstanding academic and leadership prowess during her time at Nanyang. Alicia is now reading Political Science at Yale University.

'The Humanities Programme has made me a more engaged and empathetic member of society. I take the opportunity to learn about people from around the world and have learnt to reflect on how much we have come to understand the world and how much more there is to find out about. Indeed, I am constantly surrounded by classmates who are as interested in our society as I am.'

— Lee Jing Ning, NYGH HP 2012-13

The NYGH Humanities Programme strives to produce forward thinking, creative and critical thinkers equipped not so much with 21st Century competencies but rather mastery thereof, ever mindful that the HP students of today will be the global leaders of tomorrow.

南洋女子中學校
Nanyang Girls' High School

打破思维定势，提升阅读质量
——中学生批判性思维能力的培养与评估

新加坡南洋女子中学校 — 杨梅枝老师 、苏章恺老师、康健老师

一、摘要

在瞬息万变的时代，我们必须培养学生具备21世纪必备的竞争力。众所周知，创意是必备的竞争力之一，而批判性思维是创新思维培养的前提，若缺乏批判性思维能力，创意仅是一句空话。有鉴于此，本组在三个实验班用同样的教学程序，即以国际认可的“加利福尼亚批判性思维性格分类表测量了实验班学生批判思维的六项性格特征--‘对真理的追求、开放性思维、分析能力、系统性、对自我批判性思维的自信程度和好奇心’。

我们也运用汤申杰克逊(Dr Thomas Jackson)设计的智者思维工具卡进行批判思维阅读教学。这套工具卡能协助老师引导学生以提问的方式针对课题或论点，从概念、原因、假设、推理、辨伪、论证及反证等方面作深入全面的思考。然后通过各类反馈，如学生的成绩、学生学习态度的调查、老师的观察，比较三个班级教学效果的异同，并针对批判性思维教学提出一些建议。

二、研究目的：

批判思维是思维方式和思维技巧的集粹。本实验采用了汤申杰克逊(Dr Thomas Jackson)的批判思维训练法，就如何进行正确的批判性思维阅读训练和有效论证的规则、合理的演绎和归纳推理，进行了初步的实验，希望找出能帮助学生掌握正确的思维技巧的有效方法，借此培养学生良好的思维习惯和思维品质，独立自主和自我校正的思维机能。

我们利用加利福尼亚批判性思维性格分类表测量的目的是为了帮助学生认识自我、发现和发展潜能，并激励学生的批判性思维。

三、研究问题与范围：

针对阅读教学中的批判思维训练：

1. 什么是批判思维?
2. 有哪些有效的方法帮助学生提升批判性思维能力?
3. 学生批判性思维能力的优势与弱势是什么?
4. 如何通过有效的批判思维训练，提高学生的阅读能力?

四、理论概述：

4.1《批判性思维能力的自我评估测试》（Self Assessment on Critical Thinking）以国际认可的“加利福尼亚批判性思维性格分类表”[1] (California Critical Thinking Disposition Inventory) 所提出的批判性思维者应具备的性格特征为标准，取了‘对真理的追求’、‘开放性思维’、‘分析能力’、‘系统性’、‘对自我批判性思维的自信程度’和‘好奇心’这六项性格特征为测试的标准[2]，为每个性格特征设计四个题目，为的是要让学生对自己的批判性思维能力的性格特征做出自我评估。

4.2运用智者思维工具卡进行批判思维教学

这里简介这次实验所采用的汤申杰克逊(Dr Thomas Jackson)所设计的智者思维工具卡。这套工具卡能协助老师引导学生以提问的方式针对课题或论点，从概念、原因、假设、推理、辩伪、论证及反证等方面作深入全面的思考。

WRAITEC

- What（你所说的概念是什么？）
- Reason（你这么说有何根据？证据确凿吗？）
- Assuming（论点是根据什么假设？）
- Inferences（从所提出的资料可作怎样的批判推断？）
- True（论点是否正确？如何找出真相？）
- Example（有何证据可以支持你的论点？）
- Counter-example（有何反证？能否推翻论点？）

老师一方面运用WRAITEC工具卡，训练学生作有系统的，有深度的思考，以提高学生的批判思维能力。另一方面老师也要掌握发问的技巧。发问能引发学生产生心智活动并作回答反应的语言刺激。它的重要性，常被教育家所强调：认为发问是促进学生思考的途径之一，又认为良好的发问技巧是教学成功的基础。有鉴于此，学生运用WRAITEC智者思维工具卡，再配合老师的提问，批判思维教学就能获得事半功倍之效。

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1 根据California Critical Thinking Disposition Inventory设计；出处：http://www.liberalarts.wabash.edu/assessment-notes-cctdi/

2 测试中舍弃最后一项”Cognitive Maturity”做为标准，主要是因为‘认知成熟度’不容易被测试或评估出来，因此在我们设计的《批判性思维能力的自我评估测试》中，我们不采用‘认知成熟度’做为衡量标准。

4.3思维彩色杯子

思维彩色杯子的用法千变万化，教师可根据实际的情况或需要,创意地使用彩色杯子，作为教师和学生之间的沟通工具；也可作为课室管理的辅助工具。 WRAITEC工具套中的红、黄、绿色的彩色杯子。可以在老师与学生获得共识后，代表丰富的含义： 红色杯子：表示反对、提出疑问。黄色杯子：表示中立。 绿色杯子：表示赞成、明白。

五、实验过程：

5.1 《批判性思维能力的自我评估测试》的设计依据与测试目标

5.1.1设计依据：

测试的题项皆为简单的陈述句，没有生僻的词语，学生在做测试时应该不会遇到理解题项的障碍。测试中的每个性格特征类别都有四个题项，其中两个为正面的陈述句，两个为反面的陈述句，为的是要让学生猜不出测试的项目与用意。再说，学生所作的测试卷中的题目是没有按照性格特征归类的，这样的设计是为了得出学生更真实的自我评估答案。测试卷中的选择项属于程度型选项（由1至7），学生选择对陈述的句子表示赞同或反对的程度。

完成测试的时限限制在十分钟之内，教师鼓励学生在作测试时，做出最真实且第一反应的回答。

在整个行动研究的期间，教师不得告诉学生测试的目标与详情，为的是要保持学生作答的真实性。如有需要，教师能在行动研究完成之后，与学生分享得出的数据,让学生知道他们自我评估的成果，肯定学生对行动研究的积极参与，也让学生能够对自我的批判性思维有一定的认识。

5.1.2测试目标

《批判性思维能力的自我评估测试》是以批判性思维能力需具备的性格特征为标准，让学生以此做出自我评估。教师能把收集到的数据作为前测的参照，以结构型问卷的方式来弥补开放式问卷的不足（以WRAITEC思维层次为评估标准的阅读理解测试属于‘开放式问卷’或‘无结构型问卷’），使得设计的前测更具科学性与系统性。

在没有与学生分享答案的情况下，教师以同样的这篇测试做为行动研究的后测，让学生再次对自己的批判性思维做出自我评估，教师对收集到的测试问卷做出统计，进行数据的前后对比，以此作为行动研究有效性的参考。

5.1.3《批判性思维能力的自我评估测试》 学生测试问卷的题项分类表

1. 以英文字母来表示题项的类型
   a) 对真理的追求　b) 开放性思维　c) 分析能力　d) 系统性
   e) 对自我批判性思维能力的自信程度　f) 好奇心

2.正负符号的代表性
   “+” --- 越靠近‘7’（非常赞同）性格特征的得分越高
   “-” --- 越靠近‘1’（非常不赞同）性格特征的得分越高

题号	题类	问题 Question	非常不赞同---------- 非常赞同 Strongly Disagree------ Strongly Agree						
1.	a+	我觉得要在两个对立的观点之间进行选择，不是一件容易的事。	1	2	3	4	5	6	7
2.	b-	当朋友反驳我的观点时，我会直接进行辩护。	1	2	3	4	5	6	7
3.	d+	如果我需要解决手上的一个难题，我能够将其他事情先搁置一旁。	1	2	3	4	5	6	7
4.	c+	我不能忍受人们提出没有依据的论点。	1	2	3	4	5	6	7
5.	e+	别人会找我探讨问题，因为我的决定一向很公正。	1	2	3	4	5	6	7
6.	f-	我和朋友间的谈话多局限于校园生活与课题。	1	2	3	4	5	6	7
7.	b+	我认为理解他人的看法是重要的。	1	2	3	4	5	6	7
8.	c+	朋友们遇到不能解决的问题时，会找我帮忙分析问题。	1	2	3	4	5	6	7
9.	a-	在别人眼里，我是一个很快做出判断的人。	1	2	3	4	5	6	7
10.	c-	我的看法经常受到别人的质疑。	1	2	3	4	5	6	7
11.	d-	其他人认为我总是太急于做出决定。	1	2	3	4	5	6	7
12.	f+	如果人生中，每天都能学习新的知识，认识新的事物，那将是极其美好的事啊！	1	2	3	4	5	6	7
13.	a+	我经常会反驳自己之前的观点和立场，希望能够更接近真实。	1	2	3	4	5	6	7
14.	e-	我没有足够的思考能力为复杂的难题做出公正的判断。	1	2	3	4	5	6	7
15.	d+	人们总是称赞我做事有条有理，很有系统性。	1	2	3	4	5	6	7
16.	f+	书到用时方恨少，我会尽可能地学习一切知识与技能。	1	2	3	4	5	6	7
17.	e+	我为我思考的精确性感到骄傲。	1	2	3	4	5	6	7
18.	b-	别人与我持有不同的观点时，我常感到苦恼。	1	2	3	4	5	6	7
19.	c-	我觉得要深入分析一篇章的论点是否合理，并不是一件容易的事。	1	2	3	4	5	6	7
20.	e-	阅读文章之后，要找出作者论点的不足之处，不是一件容易的事。	1	2	3	4	5	6	7
21.	b+	我为自己的偏见感到顾虑。	1	2	3	4	5	6	7
22.	a-	当我在讨论自己的看法时，我是没有办法完全公正的。	1	2	3	4	5	6	7
23.	d-	我思考问题的时候，不会循序渐进地进行推断。	1	2	3	4	5	6	7
24.	f-	我认为我没必要知道课外的知识，因为这些知识与我没有切身关系。	1	2	3	4	5	6	7

5.1.4前测

用张春玉的《从中学生谈移民的作文说起》设计阅读理解。以汤申.杰克逊(Dr. Thomas Jackson)的WRAITEC智者思维工具卡做为评分标准，如果学生有答到点，便以英文字母（WRAITEC）在答案纸上注明，方便教师做出统计。

学生的论点只要涉及到该项思维层次，教师就以英文字母注明，不管学生的论点是否扎实或正确，也不管学生的语句是否流畅。

一小时的阅读理解前测的时间安排如下：

- 讲解概念-孙旭事件、生育率下降等和引言李斯的《谏逐客书》等文言文【5分钟】
- 阅读篇章【10分钟】
- 学生提问【5分钟】
- 回答问题【30分钟】

赞同作者的看法	
What作者的论点是什么?	作者认为大多数学生对政府引进新移民的政策持反对意见的做法是不成熟的。
Reason作者这么说有何根据？证据确凿吗?	作者认为自己已经向学生解释了新加坡所面对的问题，学生应该能够理解决策背后的社会因素与背景，诸如面对生育率下降、人口老化迅速、人才短缺问题日益严重等情况。 持反对意见的学生举出的例子包括交通拥挤以致地铁瘫痪，新移民难辞其咎；还有社会治安下降、住房紧缺、房价上涨、孩子升学就业压力大，好学校、好工作都被新移民后代占据等等；作者认为他们的论点站不住脚，学生以个体利益的角度出发来考虑问题，是思想不成熟的表现，心胸狭窄并且过于务实。 作者举出了李斯的《谏逐客书》做为引证，说明国人应该持有海纳百川的精神来接纳新移民，这样一来才能使得新加坡立于不败之地，国家长盛不衰。
Assuming作者的论点是根据什么假设?	作者作出的假设： 新移民都是人才，他们能为新加坡的经济发展作出显著的贡献，使得新加坡长盛不衰。新移民的引进能解决新加坡生育率下降、人口老化迅速、人才短缺日益严重等问题。历史告诉我们，长盛不衰的国家都需要保持不拘一格、有容乃大的广阔胸襟来接纳人材，唯有在能够持续吸引顶尖人材的情况下，新加坡才能一直繁荣发展。
Inferences（我可以从所提出的资料中，对作者的论点作出怎样的推断与判断？）	从文章中看得出，作者认为持赞同意见的学生所举出的例子，都是从集体利益角度出发的；持反对意见的学生所举出的例子，都是从个体利益的角度出发的。 从集体利益出发的观点是成熟的，从个体利益出发的观点是不成熟的。

True论点是否正确？如何找出真相？	正确。引用报章上专家学者的观点和新加坡统计局所公开的数据进行论证，说明新加坡引进的都是外来人才，而这些人才对新加坡的经济发展做出显著的贡献，而这些外来人才的引进能够解决生育率下降、人口日益老化和人才短缺等问题。唯有在维持经济持续发展的情况下，才能确保国人优质的生活和幸福。
Example有何证据可以支持我的论点？	引进新移民除了能解决生育率下降、人口老化迅速、人才短缺问题日益严重等问题之外，引进新移民也能提高新加坡的竞争力，鞭策新加坡人，使得国人会力争上游，不断学习新知识与技能，适应新的全球竞争环境。 填补无人能够胜任，或无人愿意做的工作。使得新加坡迈向一个国际化的大都市。
Counter-example有何反证能推翻我的论点？	

不赞同作者的看法	
What作者的论点是什么？	作者认为大多数学生对政府引进新移民的政策持反对意见是不成熟的。
Reason作者这么说有何根据？证据确凿吗？	作者认为自己已经向学生解释了新加坡所面对的问题，学生应该能够理解决策背后的社会因素与背景，诸如面对生育率下降、人口老化迅速、人才短缺问题日益严重等情况。 持反对意见的学生举出的例子包括交通拥挤以致地铁瘫痪，新移民难辞其咎；还有社会治安下降、住房紧缺、房价上涨、孩子升学就业压力大，好学校、好工作都被新移民后代占据等等；作者认为他们的论点站不住脚，学生以个体利益的角度出发来考虑问题，是思想不成熟的表现，心胸狭窄并且过于务实。作者举出了李斯的《谏逐客书》做为引证，说明国人应该持有海纳百川的心态来接纳新移民，这样一来才能使得新加坡立于不败之地，国家长盛不衰。
Assuming作者的论点是根据什么假设？	作者作出的假设：新移民都是人才，他们能为新加坡的经济发展作出贡献，使得新加坡长盛不衰。新移民的引进能解决新加坡生育率下降、人口老化迅速、人才短缺日益严重等问题。 历史告诉我们，长盛不衰的国家都需要保持不拘一格、有容乃大的广阔胸襟来接纳人材，唯有在能够持续吸引顶尖人材的情况下，新加坡才能一直繁荣发展。
Inferences我可以从所提出的资料中，对作者的论点作出怎样的推断与判断？	持赞同意见的学生所举的例子，都是从集体利益角度出发的；持反对意见的学生所举出的例子，都是从个体利益的角度出发的。从集体利益出发的观点是成熟的，从个体利益出发的观点是不成熟的。

True论点是否正确？如何找出真相？	不赞同。对作者的假设进行反驳和解析： 新加坡近年来放宽对外来人材引进的条例，造成的是许多进来的新移民非真正的人材，长远以来，对新加坡的发展不一定会做出显著的贡献。 新移民的引进不一定能解决新加坡生育率下降、人口老化迅速、人才短缺日益严重等问题。生育率的下降和人口的迅速老化等问题为国家的经济发展带来负担，但是，引进外来人材不是解决经济发展负担的最佳方法。提高国人的生产力、提高退休年龄、改变国人看待工作的观念、鼓励企业购买机器来替代人力资源，实行产业链的自动化等措施可能会更好地解决经济发展负担的问题。人材短缺的问题可能更多是教育体系或教育政策的问题，培养出来的本地人材不具备工作市场所需要的技能。 ‘海纳百川，有容乃大’的精神是重要的，但在民主制度的体系下，国家与人民，或是人民与人民之间存在着‘社会契约’，人民需要为国家的发展与国人的共存与幸福做出贡献，但是，国家也有必要为自己国人的幸福与生活素质负责。‘引进外来人材有利于国家’的这一论点，建立在外来人才能为我国做出贡献，维持我国的经济发展，而经济繁荣发展会为国人带来幸福的这一层假设的基础之上。引进外来人才是必需的，但讲究的是一个‘度’，在维持国家经济发展与维持国人幸福指数上寻求一个平衡。因此，作者认为学生都是以个体利益出发，学生的思想观点都是不成熟的，这是有欠公允的。
Example有何证据可以支持我的论点？	文中指出的例子：交通拥挤以致地铁瘫痪，新移民难辞其咎；还有社会治安下降、住房紧缺、房价上涨、孩子升学就业压力大，好学校、好工作都被新移民后代占据等等。 国家应该以人民的生活与幸福程度为衡量经济发展的尺度，而不是人为经济发展带来的物质享受就等同于幸福。况且，外来人材的引进标示着人口的增加，在资源紧缺和人口增加的情况下，必定会造成结构性的通货膨胀（有争议性），物价和屋价上涨，国人的购买力回复到原有水平，因此，人材的引进会带来经济的增长，却不一定会为国人带来幸福（当然，幸福是很主观的概念）。幸福指数（NHI不丹为例子）vs 经济发展（GNP经济增长总值）
Counter-example有何反证能推翻我的论点？	

5.1.5批判思维阅读理解后测

以叶鹏飞的《不以家事辞王事》设计了一系列问题，考查学生的批判思维能力。

赞同/不赞同作者的看法	
What作者的论点是什么？	从政者的私德是否会影响其政治生命？ 作者认为在人际关系日益复杂的后现代社会，婚外情已经是个难以忽视的现实”，“从政者也是凡人，也有凡人的七情六欲，对他们的私德自然就不能太过苛求”，“有献身精神、能力且愿意服务人民的人才，本来就不是那么多”，作者担心如果我们“采取超乎社会大众的双重标准来要求他们的私德，会否让潜在者却步不前”？ 对于私德要求的标准，其实并非绝对的，而是取决于特定时代特定社会的主流价值。 当代民主政治，只要不影响公共利益，从政者的私人行为应当获得尊重。
Reason作者这么说有何根据？证据确凿吗？	作者认为柏默似乎与饶欣龙一样，只是私德有亏，仅有政治责任，没有司法问题。他们没有违反公众利益。从政者也是凡人，也有凡人的七情六欲，对他们的私德自然就不能太过苛求。
Assuming作者的论点是根据什么假设？	作者作出的假设：在历史经验里，私德未必是公德的前提保障，许多私德检点者却是危害公德，甚至犯下滔天大罪的恶魔。希特勒烟酒不沾，也不贪女色，更在苏联红军攻入柏林，准备自杀前，正式迎娶了女伴侣为妻，给予名分。 婚外情是否有涉及公众利益冲突？唯有公开透明，对公众有妥善的交代，才能确保本地政治文化的正直和清廉。 柏默是一名尽责的议员，在基层辛勤耕耘，照顾选民的需要；他也是一名称职的议长，连国会在野党领袖刘程强也公开承认这点。至少在公德上，柏默并无愧于选民的委托。作为议长，他唯一还必须做的，是向社会大众交代自己的婚外情仅止于此，并无损害公共利益。
Inferences我可以从所提出的资料中，对作者的论点作出怎样的推断与判断？	从文章中看得出，作者认为 持赞同意见的所举出的例子，私德未必是公德的前提保障。在公德上，并无愧于选民的委托，无损害公共利益。有国人愿意区分公德与私德，不认为尽责的议员必须因婚外情而辞职。
True论点是否正确？如何找出真相？	正确：引用报章上政治人物、专家学者的观点和统计数据进行论证，说明私德要求的标准，其实并非绝对的，而是取决于特定时代特定社会的主流价值。 所谓千军易得，一将难求，有献身精神、能力且愿意服务人民的人才，本来就不是那么多，如果又采取超乎社会大众的双重标准来要求他们的私德，会否让潜在者却步不前?或许需要国人集体思考，对于从政者，到底应该采取什么样的道德标准。 不正确：持反对意见的所举出的例子，我们是否应该接受我们的领袖在私德上有瑕疵？你能想象并接受你社区的议员在大庭广众之下道貌岸然地慷慨陈词，而背后却干着不可告人的勾当？ 参考：12月18日联合早报张春玉《柏默辞职引发的思考》及12月16日韩咏梅《色戒--柏默事件的两点思考》

Example有何证据可以支持我的论点?	把公众人物在公领域与私领域的表现拿来比较是残酷的。儒家社会推崇“内圣外王”，主张个人私德良好，才能发挥公德，管治好国家。西方社会却区分公德私德，认为只要不影响公众利益，一切个人行为纯属个人选择。把私德审判置于公共监督之上，也是危险的。 美国前总统克林顿的“拉链门”，固然被媒体大量报道，公众却没有随之大力讨伐。政敌弹劾他的，是他的不诚实，与其私生活无关。在政治人物涉及情欲新闻时，人们应当关心的是他有无借着自己职务，行使不当的行为。一味挖掘当事人的情欲内容或者情史，其实模糊了焦点。 在真诚的认错之后，我们的社会是不是会考虑接受这个人？如果真的有悔过之心，拿出勇气身体力行去纠正偏差，重新赢得人们的信任，这个过程是不是远远比道歉、下台来得具挑战性？—韩咏梅《色戒--柏默事件的两点思考》
Counter-example 有何反证能推翻我的论点?	可以预见的是，伴随这类新闻频频发生，或许人们的“惊吓度”会递减，容忍度会增加。 柏默的私德与我何干？”“时至今天，要寻找大批既十分能干，私德又完美的‘楷模型’人物已越来越困难。”“当变化的时代已经来临，要追求这种理想的成本自然会水涨船高。如果建立与维护一支私德完美的政治队伍日益艰难，这层现实又意味着国家必须支付更高薪酬给政治人物作为补偿，那就与我有关了”。

六、分析与讨论

6.1《批判性思维能力的自我评估测试》及学生测试问卷的题项分类表测试结果分析
参与研究实验的班级有409（36人），413（30人），414（23人）。

以学生对于批判性思维能力的自我评估来看，我们对学生的思维模式有一个初步的解读。尤其是当我们将给予学生完成的题目进行系统性的归类和分析后，可以得出以下一些观察。

• 对真理的追求
从学生的自我评估来看，我们可以得知她们对于真理是存着某种程度的追求。虽然性格特征不是非常明显（即平均值并没有在介于1-3 或5-7的范围内），但是还是能看出她们经常会反驳自己之前的观点和立场，希望能够更接近真实。(4.71) 然而学生的另一个问题是她们会很快的做出判断（3.87），从另一个角度去理解的话，或许说明了学生在做出判断前可能未经过非常详细的思考、自我批判或假设。

• 开放性思维

调查结果显示学生挺认同与理解他人的看法（+5.91）。 但相对的为自己的偏见感到过分的顾虑。(+4.14) 这或许表示了学生在开放性思维方面还是不够全面。尤其当我们看到当别人与他们持不同或反对观点时，他们会感到苦恼多于直接为自己进行辩护，（-3.62 vs -4.62）这显示她们在开放性思维能力方面仍有进步空间。

• 分析能力

调查结果显示学生非常清楚如果一个观点要站得住脚，相应的依据分析是非常重要的(+4.67)。但是她们在这方面的能力还是有所欠缺，尤其是她们都认为自己的看法经常受到别人质疑（-3.46），反映了学生在分析能力方面自认有所不足之处。

• 系统性

结果显示学生大致认为自己属于处理事务时有系统性的人。（+4.8 和+4.05）。然而他们总是太急于做出决定（-3.18），不会在思考问题时循序渐进地进行推断（-3.59）。这显示学生在进行思考时，缺乏有系统的推断和批判能力，习惯停留在比较表面的讯息上，便即刻做出所谓的判断或决定。

• 对自我批判性思维能力的自信程度

结果显示学生对自己的自我批判性思维能力有一定的自信(+4.34 和+4.7)，同时觉得自己没有足够的思考能力来为复杂的难题做出公正的判断(-3.24)。这或许反映出学生在一定的程度上觉得自己有一定的自我批判的思维能力，但却对自己这一能力持保留的态度。当然，这尤其表现在当学生所面对的是一些较为复杂的难题，相应的自信程度肯定会大受影响。

• 好奇心

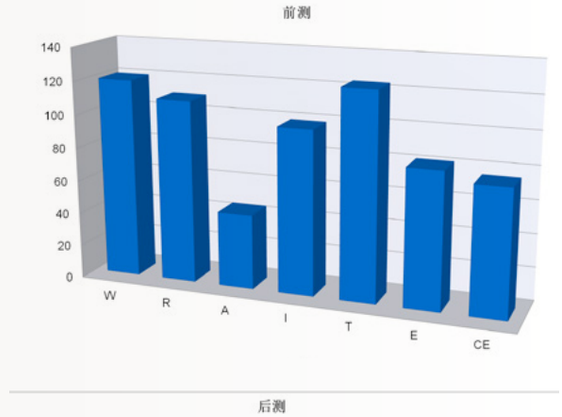
结果显示学生非常赞同学习新知识的重要性（+5.37 和 4.8）。然而另一方面却实实在在地反映出学生严重缺乏学习新知识的好奇心。由于学生认为自己没有必要知道课外的知识(-1.92)，和朋友之间的谈话也多限于校园生活与课题(-3.0)，这反映了学生在课外知识的缺乏，显示了学生缺少发掘新知识的好奇心。这极有可能影响学生的思考及批判能力，以及进行反证时必备的知识。

题号	题类	问题	平均值			
		a) 对真理的追求	309	313	314	三班平均
1.	a+	我觉得要在两个对立的观点之间进行选择，不是一件容易的事。	4.8	4.5	4.5	4.63
13.	a+	我经常会反驳自己之前的观点和立场，希望能够更接近真实。	5.1	4.1	4.7	4.71
9.	a-	在别人眼里，我是一个很快做出判断的人。	4	3.9	3.7	3.87
22.	a-	当我在讨论自己的看法时，我是没有办法完全公正的。	4	4.4	4.4	4.37
		b) 开放性思维				
7.	b+	我认为理解他人的看法是重要的。	6	5.9	5.8	5.91
21.	b+	我为自己的偏见感到顾虑。	4	4.2	4.1	4.14
2.	b-	当朋友反驳我的观点时，我会直接进行辩护。	4	4.8	4.7	4.62
18.	b-	别人与我持有不同的观点时，我常感到苦恼。	3.5	3.9	3.6	3.62
		c) 分析能力				
4.	c+	我不能忍受人们提出没有依据的论点。	4.6	4.5	4.9	4.67
8.	c+	朋友们遇到不能解决的问题时，会找我帮忙分析问题。	4.9	4.8	4.5	4.32
10.	c-	我的看法经常受到别人的质疑。	3	4	3.4	3.46
19.	c-	我觉得要深入分析一篇文章的论点是否合理，并不是一件容易的事。	5	4.4	4	4．5
		d) 系统性				
3.	d+	如果我需要解决手上的一个难题，我能够将其他事情先搁置一旁。	5.1	4.6	4.8	4.8
15.	d+	人们总是称赞我做事有条有理，很有系统性。	4.3	4	3.8	4.05
11.	d-	其他人认为我总是太急于做出决定。	3	3.6	3.1	3.18
23.	d-	我思考问题的时候，不会循序渐进地进行推断。	3.4	3.7	3.7	3.59
		e) 对自我批判性思维能力的自信程度				
5.	e+	别人会找我探讨问题，因为我的决定一向很公正。	4.6	4.5	3.9	4.34
17.	e+	我为我思考的精确性感到骄傲。	4.7	4.8	4.6	4.7
14.	e-	我没有足够的思考能力为复杂的难题做出公正的判断。	3.1	3.4	3.2	3.24
20.	e-	阅读文章之后，要找出作者论点的不足之处，不是一件容易的事。	4.4	4.1	4.2	4.26
		f) 好奇心				
12.	f+	如果人生中，每天都能学习新的知识，认识新的事物，那将是极其美好的事啊！	5.8	4.7	5.3	5.37
16.	f+	书到用时方恨少，我会尽可能地学习一切知识与技能。	5.3	4.5	4.4	4.8
6.	f-	我和朋友之间的谈话多局限于校园生活与课题。	3.1	2.7	3.2	3
24.	f-	我认为我没有必要知道课外的知识，因为这些知识与我没有切身关系。	1.8	1.9	2.1	1.92

6.2前测阅读篇章结果分析

学生最能掌握测试其辨伪(True)、概念(What)和原因（Reason） 的思维能力的题型。 如参照布鲁姆的“教育目标分类法”，在认知领域的教育目标，学生基本上都掌握了知道（知识）、领会（理解）和应用的层面。

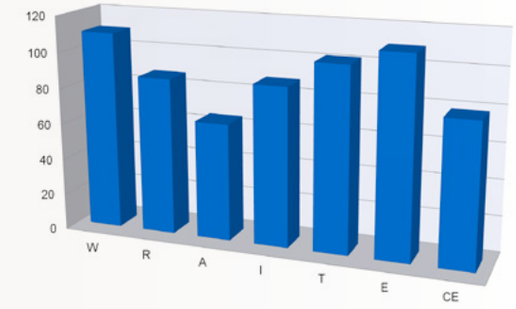
学生最不能掌握测试其假设 (Assuming) 和反证（Counter-example） 的思维能力的题型。 这也反映了学生之前所完成的《批判性思维能力的自我评估测试》。测试显示出她们在思考是还不够全面，不会进行假设，也欠缺好奇心，以致不重视课外知识，造成在反证能力上的不足。 因此老师在设计之后的教学时，会更注意加强这方面的思维能力训练。



6.3后测阅读篇章结果分析

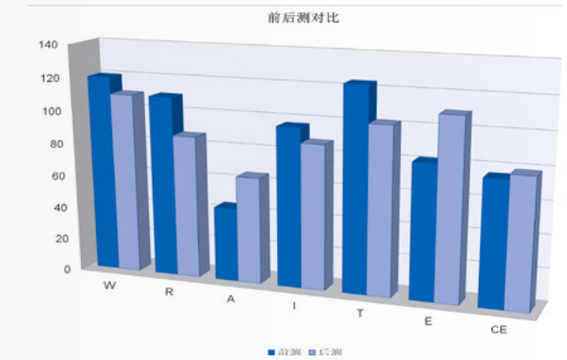
学生最能掌握测试其辨伪(True)、概念(What)和论证（Example）的思维能力的题型。

学生较不能掌握测试其假设 (Assuming) 和反证（Counter-example） 的思维能力的题型。



前后测成绩中变化最大的是论证思维能力（Example）。其中的原因可能包括老师在后测篇章测试时，同时提供了额外的辅助材料，帮助学生获取更多相关的知识。 由此可见提升学生的阅读质量对于其思维能力是有一定的影响的。 虽然当中得分最低的仍是测试其假设(Assuming) 和反证（Counter-example） 的思维能力的题型，但两者在前后测得分都有增加。

从得分率的方面进行分析，以假设 (Assuming) 为例，在前测学生获得满分（即两分）的得分率只占了1.27%。 到了后测时，拿满分的得分率升至23.81%。 从中可看出学生在这方面的思维能力是有所提升的。



至于反证(Counter－example) 部分，虽然从整体得分来看，由前测的76到后测的88增加率不到15%。 但从得分率的方面进行分析，在前测学生获得零分（即完全答错）的得分率占39.24% 。到了后测时，得零分的比率下降至16.67%。从中可看出学生在这方面的思维能力也是有所提升的。

七 总结

这次教研，三个班级的师生，在百忙中竭尽所能互相配合，充分发挥了集体协作精神，使实验在短短一年内完成。

教研结果显示，利用批判性思维性格分类表测量有助于学生认识自我、发现和发展潜能，并激励学生的批判性思维。利用智者思维技巧、苏格拉底讨论法、分组讨论、辩论等从概念、原因、假设、推理、辩伪、论证及反证等方面作深入全面的思考，都是锻炼学生批判性思维能力的方法。

这些方法与一些辅助性工具，如智者思维工具卡（WRAITEC），彩色思维杯子、分组讨论角色卡等对于学生学习批判性思维技能都有帮助，它们也使课堂学习氛围更活跃，促进师生之间的思维交流，从而迸发出许多具有深度与广度的论点，论据，学习成果也令人鼓舞。

经过半年的教学实验，我们发现这些历久弥新的教学法在调动学生的积极性，引导学生进行批判性思考，清楚表述其见解，与同学之间交流互动；以及教师全面深刻地评价学生的学习，对自身教学实践进行反思，检验其教学有效性诸方面都有重要的现代意义。

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南洋女子中學校
Nanyang Girls' High School

NYGH Backyard Project

Nanyang Girls' High School, Experiential Learning Department –
Mr James Ong Beng Kooi, Ms Natalie Teng Yueng Shan, Mr Lim Cheng Puay

The Nanyang Backyard project is the creation of an outdoor learning space incorporating elements of outdoor learning, environmental education and experiential learning. This space aims to provide opportunities for students to develop themselves in the physical, sensory and affective domains. The Nanyang Backyard was set up based on the principles of sustainability and through instilling a strong sense of ownership with various stakeholders. Through a better connection with nature and the environment, we hope to achieve a more holistic development for our students.

Introduction

The Nanyang Backyard project is the creation of a outdoor learning space incorporating elements of outdoor learning, environmental education and experiential learning.

This initiative started as a collaboration between Nanyang Girls' High School and the WOW Kampung from Ground Up Initiative Singapore (http://www.groundupinitiative.org), positioning Nanyang to be the first school in Singapore to create a space that integrates experiential learning, character education, environmental education and multidisciplinary collaboration.

This project was made possible by the generous donation of a seed fund of S$5000 from the graduating batch of students of 2012. This gesture is good example of the Nanyang spirit on creating a sustainable and enduring legacy for future batches of students.

The 12m x 12m space was designed to allow free access for all staff and students for a variety of activities. It has the capacity to hold a class of 30 students for an outdoor learning lesson and serves as a place for recreation after lessons. Over 20 species of plants were planted, transforming the space into an outdoor learning platform. With introduction of plants, the biodiversity of the place has increased. There are now more insects and birds visiting the area. The intent of the space was to allow a close proximity with nature and encourage interaction with the environment.

Need for an outdoor learning space

In the current digital age, there is a strong emphasis on leveraging on technology for teaching. This is a real need given the pervasiveness of technology in many aspects of our students' lives. Technology can enhance

the learning and teaching process. Many hope that using technology in the classrooms can enable students to be adaptable and relevant to future changes (Daipi 2012).

One consequence of the digital age is the loss of connection with the natural environment, an observation which prompted Richard Louv to coin the term “Nature Deficit Disorder”. One of the causes of this loss of connection is competition for attention from electronic media (Louv 2009). This has environmental, social and psychological implications. For example, studies show that disconnection with the natural environment results in a higher tendency of depression, hyperactivity, boredom and loneliness (Jardine 2010).

As educators, we know that the holistic development our students is a multifaceted endeavor. It is equally important to consider the holistic development of the children in other areas of intelligence and faculties. Besides cognitive development in the classrooms, we need to provide opportunities for students to develop themselves in the physical, sensory and affective domains.

This need for interaction with the natural environment for young Singaporeans was also articulated by Mr Tay Kheng Soon, an acclaimed local architect. In an interview with the TODAY newspaper, Mr Tay commented on what it takes to design for resilience for young Singaporeans (Lee 2013). He said:

> **“Thus, I am concerned for young Singaporeans growing up in a concrete environment, deprived and therefore fearful of natural things. I fear they deprive themselves of developing instincts that would serve them well, directly or indirectly.**
>
> **If these natural impulses are present, people will see things more holistically, rather than as separate entities which make them easily dictated to by the imperatives of today’s urban industrial culture — like being strapped to jobs they don’t enjoy, tied to heavy mortgages, stressed out by children’s school woes, and needing distraction through lots of retail therapy.” (Lee 2013)**

His observations highlight the issues that the Nanyang Backyard Project hopes to address.

The Nanyang Backyard Project serves to achieve the following objectives:

To provide a learning space for staff and students to EXPERIENCE, LEARN and ACT. (Enabling Nanyang, Growing Nanyang, Inspiring Nanyang)

1. EXPERIENCING – actual hands on experience (Enabling Nanyang)

a. To foster habits of meaning-making through experiential learning and reflection

b. To use the space for meaningful outdoor experiences and learning with the intent of positively influencing individual growth and improvement in social skills. (affective and cognitive)

2. LEARNING – content development, skill building (Growing Nanyang)

a. Create opportunities for multidisciplinary collaboration and learning (affective and cognitive), enhancing current academic content

b. Build social skills and competencies through outdoor education programmes (e.g. social enterprise skills)

3. ACTING – inculcating values, attitudes and forming habits (Inspiring Nanyang)

a. To develop a sense of self-worth, rootedness and connectedness

b. To acquire attitudes of care and concern for others and environment

c. To create and maintain healthy, positive, sustainable relationships between people and the environment

Design Concept of the Backyard Project

The Nanyang Backyard was set up based on the principles of sustainability and through instilling a strong sense of ownership with various stakeholders. Working with our partner, WOW Kampung, Nanyang staff and students learnt the basics of planting herbs and how to create built structures and scaffolds for plants.

Through the process, we used recycled items such as discarded timber and old furniture. We were fortunate to acquire wood donated from Resort World Sentosa for the construction of the garden. During the building of Resort World Sentosa, the wood from the cleared forest was collected and kept in their nursery. This wood was kindly donated to the Backyard Project and used for various structures such as the trellis for climbing plants and laying of pathways.

The actual space puts into consideration various key elements such as harvesting of rainwater to decrease flooding, putting in plants for multisensory interaction, growing native plants for education about our natural heritage and also sharing about how we grow our food.

Using the space for placed based learning

Since its opening in August, various groups of staff and students have been actively using the space. In less than 2 months of its opening, a variety of outdoor learning lessons, such as talks on marine conservation, composting lessons, academic lessons as such Integrated Humanities lesson on fairtrade had been carried out.

We are glad to share some of the reflections and feedback from students and staff who have used the space.

Student reflections:

"I feel that the Backyard Project is particularly significant in our school as it provides a space for students to interact with nature and come to appreciate the other living things that exist in our land, an opportunity that is rather rare in our fast-paced modern lives. In helping out with maintenance duties in the garden, I have felt myself grow closer to the earth, by having a stake in this space that we all care for together. The delight of unearthing an earthworm, seeing a toad hop by, or have our teachers hiss at us to look at the hornbill across the road; is just an instance of the simple yet forgotten pleasures in life. By being constantly reminded of what is at stake and what we stand to lose, remaining in contact with nature is paramount in keeping our passion for environmental conservation alive."

Feedback from staff:

"I feel that students can learn better with an authentic learning experience when they have to use actual tools of the trade... The fact that the students are not structured into a neat package of learning means that students are forced to learn by themselves. This in itself is authentic and students will be intrinsically motivated to learn."

Moving forward

The Backyard project is still in its infancy stage. There will more plans to collaborate amongst different disciplines to design and implement more placed based learning activities. We also hope to launch more

student-initiated projects such as documenting the biodiversity of the area or exploring how food is grown and harvested.

We also would like to take this opportunity to invite our partners to visit the place or to design more placed based learning lessons together.

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Planting the plants in the backyard by staff and students

Building of the soil bed for the herb section

Successful completion of Phase 1 of Backyard Project

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Characterising good extension activities for a high-ability year-9 mathematics set

The Perse School, Cambridge, United Kingdom – Dr Holly Hedgeland

The research aims to identify trends to guide the selection of extension activities that produce significant benefit whilst minimising negative impact on the motivation of less able members of the class. In the first part of the study, two extension activities were carried out. For each activity, exercises were marked to give quantitative data on the students' progress and questionnaires were completed by the students both before and after the activities to gauge the impact on the group's attitudes to learning. The second part of the study sought to gain a greater understanding of the motivation of the students undertaking extension tasks by giving free-choice between three activities, with the students completing a questionnaire afterwards to give their perception of the activities and the impact of them on their wider enjoyment of mathematics and confidence in the subject. It is concluded that the perception of both extension activities and mathematics as a whole appears to be based upon the students' wider impressions, rather than easily influenced by individual sessions.

Literature Review

There has been extensive debate concerning the best approach for students showing a high-ability in mathematics, and the concept of ability itself remains controversial. We are not seeking to enter into that latter argument here, but instead accept that, at any given point, some members of the group will engage more quickly with tasks and more easily progress to higher levels of learning. If we take Bloom's taxonomy as a structure for these levels (Krathwohl, 2002), then recent work by Smith describes well an experience with which many teachers will be familiar when seeking to encourage pupils to move beyond merely applying rules to greater analysis and creativity (Smith, 2012).

The "acceleration versus extension" debate surrounding the best approach to encouraging development in mathematics has also proved divisive, although a useful review of the possible virtues and pitfalls associated with both approaches was published by White et al. under the Local Government Association educational research programme (White et al, 2003). Recent publication of a comparison of the mathematics skills of school children in England and East Asia (Jerrim and Choi, 2013), does also suggest that a certain amount of what we consider to be acceleration might constitute a "normal" pace elsewhere. Hence a balance between moderate acceleration within the national context, and a programme of extension activities, could provide a stronger approach than either acceleration or extension in isolation. Although this research considers only classroom-based extension, an interesting complementary study of out-of-school programmes for this age-group has recently been made by Feng (2010).

Research Question

2.1 Research Objectives

In seeking to answer our main research question,

> "What characterises a good extension activity for a high-ability year 9 mathematics set?",

we need to expand further on the meaning of "good" within this context. For the purposes of this research, the following aspects have been considered:

- What is an appropriate level of extension activity?
- How is the group's confidence affected by extension?
- Which methods of delivery maximise positive impact?

2.2 Research Implementation Process

In the first section of the research, two different extension activities were chosen in topics where the group had no significant prior knowledge but was able to progress from a basis of established skills and techniques through a number of levels of increasing complexity. The learning outcomes were assessed quantitatively in order that the students' progress could be compared with a benchmark data set of the results from recent year-wide tests. For both activities, qualitative survey data was also used to monitor pupil perception of the extension tasks and their impact on attitudes to learning, with questionnaires being completed before and after the activities in order that changes could be mapped accurately.

The first activity was teacher-led, aiming to develop the students' skills in sketching graphs of quadratic functions, starting with the application of familiar techniques to find intercepts and developing the method of completing-the-square to locate the turning points before finally making a sketch of the quadratics. Exercises to practice completing the square and sketching curves were then completed individually in class, with a further set for homework. The homework exercises were taken in and marked to provide quantitative data about performance in this activity.

In the second activity, the pupils worked through a guided booklet studying the gradients of curves and their tangents, leading to some basic ideas connected with the derivative of a function. The activity was presented as

an investigation, and collaborative work with peers was encouraged. Two teachers also circulated throughout the activity to provide assistance and further discussion of the topic. The investigation booklet concluded with a page of exercises based on the material introduced through the earlier narrative. The marks from these exercises provide the quantitative assessment of the students' progress in this activity.

A second section of research then sought to explore the students' motivation within extension work and the effects of granting autonomy. The students were offered free-choice of three extension activities, which were carried out in the next double lesson:

- Learning about permutations and combinations, taught in a small class group;
- A computer-based lesson on sequences and series using myMaths lessons and tasks;
- Investigating complex numbers and fractals using a worksheet and spread sheet from the Royal Institution Maths Masterclasses.

The three topics had been chosen to be of approximately equal demand, but with different methods of delivery. No quantitative assessment was made of the pupils' progress with the activities but, in the following lesson, all were asked to complete a questionnaire to look at the motivation of their choice and reaction to the activity.

2.3 Research Target

Exceptional ability students are necessarily taught with less able peers, even within generally high-ability groups. The choice of extension activities must be made carefully if the potential of the most able is to be realised without creating a negative experience for the less able.

In a class with a significant fraction of exceptionally able students (over 25% receiving Mathematical Olympiad medals in the current year), there is a clear need to develop beyond the typical Year 9 scheme of work if these students are to maintain their interest in mathematics and fulfil their potential. However, not all students in the set fall within this category and experience informs that some extension activities and methods might not be to everyone's benefit. The aim is to foster the perception that extension is interesting, although may be challenging as an activity that is so difficult as to be demoralising is not at an appropriate level.

As the school has an additional intake at Year 9 from a number of local preps, we must be aware that the students have a variety of previous learning experiences. The recent conversion of the 11-16 section of the school to co-education has also resulted in 15% girls within the class, somewhat below that of the wider year-group. Whilst it would be difficult to consider this small group separately with any statistical certainty, we should remain sensitive to any apparent disparities between the reactions of this group and those of the class as a whole.

Research Results and Analysis

The first activity, curve sketching, appears to have had little effect on the attitude of the class towards mathematics, or their perception of whole-class extension activities. The questionnaire that the students completed asked them to state on a scale of 1-4 how happy they felt in advance of, and during, maths lessons; the results are shown in Figure 1a for the surveys conducted before and after the activity. Figure 1b shows the variation in perception of whole-class extension work, also on a 4 point scale, ranging from "very easy" to "very hard". The scores in the marked exercise are shown in Figure 1c, plotted against the students' results from recent year-wide progress tests. Here little correlation is noted, with a large number of very high marks in the extension exercise, but with a not-insignificant few achieving a relatively poor result.

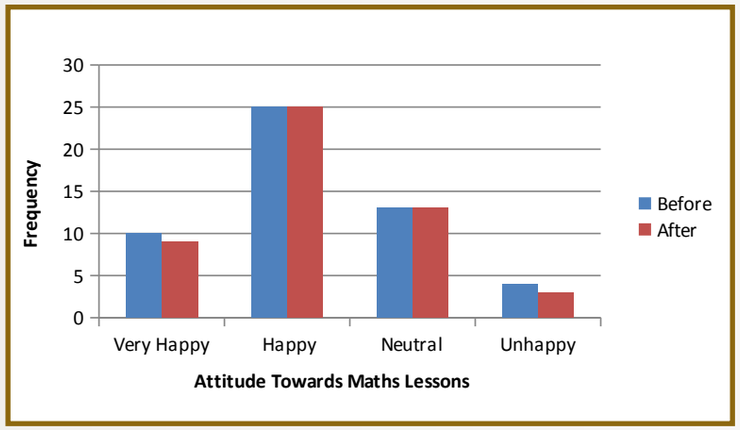

Figure 1a. Showing the class' attitude towards maths lessons before and after the first intervention, with happiness with mathematics marked on a four-point scale from "unhappy" to "very happy".

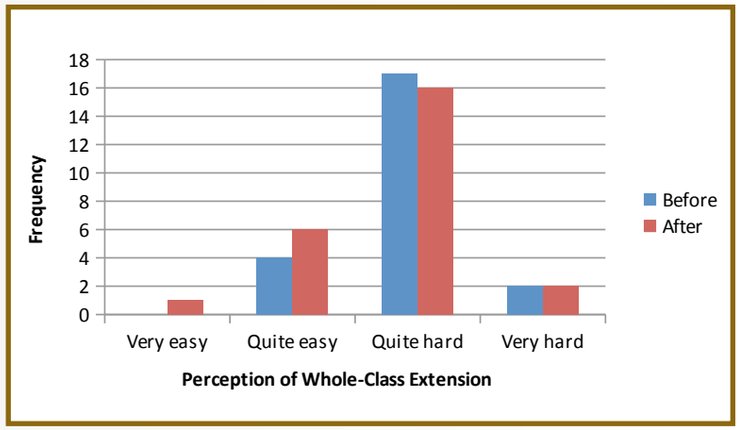

Figure 1b. Showing the class' perception of extension work before and after the first intervention, with the difficulty of the work marked on a four-point scale from "very easy" to "very hard".

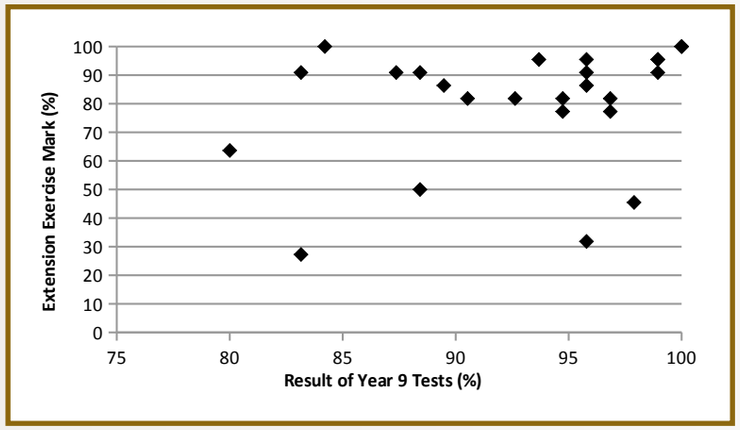

Figure 1c. Showing the marks from the assessed exercise of the first intervention plotted against the students' recent scores in year-wide tests.

The second activity produced a similarly small shift in the attitude of the students towards mathematics and their perception of extension work. The differences seen in Figure 2a are due to a small number of absences on the day of the survey rather than a significant alteration in the overall shape of the distribution of the responses, with a similar pattern also seen in Figure 2b.

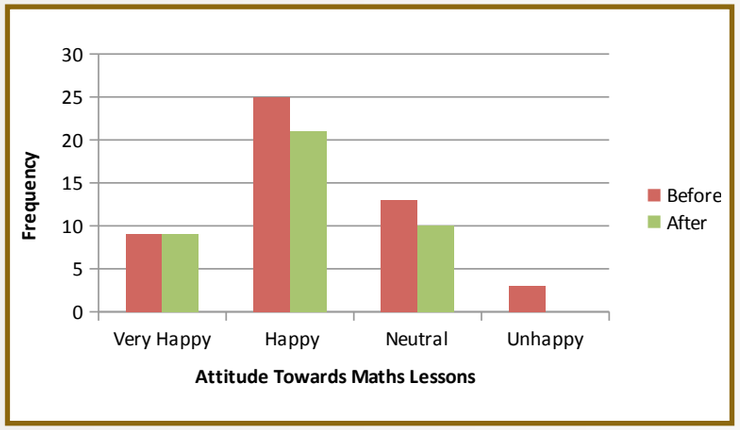

Figure 2a. Showing the class' attitude towards maths lessons before and after the second intervention, with happiness with mathematics marked on a four-point scale from "unhappy" to "very happy".

Figure 2b. Showing the class' perception of extension work before and after the second intervention, with the difficulty of the work marked on a four-point scale from "very easy" to "very hard".

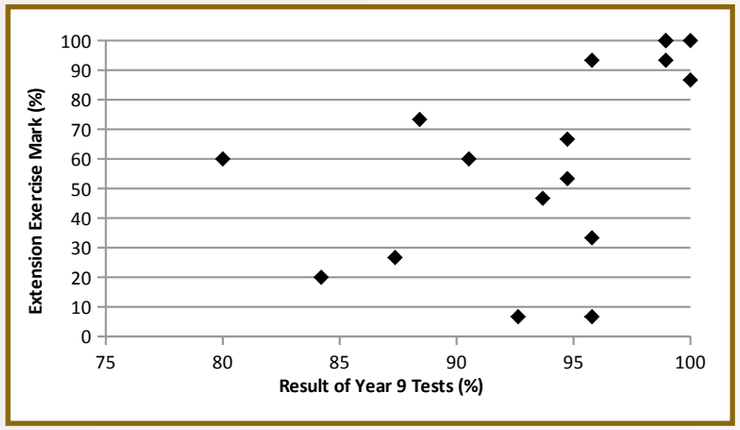

Figure 2c. Showing the marks from the marked exercise at the end of the second intervention activity plotted against the students' recent scores in year-wide tests.

Figure 2c is rather more revealing than might be expected from the students' relatively unchanged perception of extension work. The marked exercise formed the final section of the booklet that the students had been using to guide them through their investigations. The students were told that this section of the work would be collected and checked, but that the marks would not "count" as feedback to them would be in terms of comments rather than a score. Some students, who had made less progress during the activity, were hence content to hand in fairly incomplete work and we see a significant scatter of marks as a result.

As the second section of the research projects involved looking at the students' motivations when faced with a free-choice of activity, it is first interesting to note the numbers selecting each option:

Topic	Delivery Method	Participants
Permutations & Combinations	Taught small-group	3
Sequences & Series	Computer-based	11
Fractals	RI Masterclass	11

Table 1. Uptake of the three free-choice activities.

The students were asked to select the most important factor in their choice of activity from a list of five options. The responses are shown in Table 2, separated by activity, with the numbering following from that given in Table 1.

Most important factor in choice of activity	Activity 1	Activity 2	Activity 3
Perceived level of challenge	3	1	2
Medium of delivery	0	2	1
Topic of the activity	0	3	7
Opportunity to work with others	0	0	1
Choices of peers	0	5	0

Table 2. Showing the factor deemed by the pupils to be the most important in their choice of activity, subdivided to show variation by activity chosen.

Finally the students were asked to say whether the activity they selected has affected their confidence in mathematics. The responses can be summarised:

Confidence Increased	Confidence Unaffected	Confidence Decreased
7	15	4

Table 3. Summary of responses to being asked to state how the activity has affected the individual's confidence in mathematics.

Returning to the first activity, and Figure 1, it appears that on the whole the uptake of the material was good, with most pupils finding it accessible. There is no significant change in attitude caused by the activity, although a small shift is seen towards finding extension work easily approachable. Anecdotal evidence suggested that that not a few of the low marks in the quantitative section were caused by students having disengaged from putting their usual effort into the work due to close proximity to the Christmas holidays and the fact that the work was acknowledged to be extension. It is hence concluded that the topic was at an appropriate level but that alterations to its delivery might have helped to keep the whole class fully engaged. In part, this outcome led to the use of an "investigation" style for the second activity, and the development of the second section of the project to consider the students' motivation in more detail.

The second activity, as an investigation, allowed the pupils much more scope to proceed at the pace they desired. Some highly-motivated and able pupils completed the work within the allocated double and were set further extension tasks to consider by the members of staff circulating around the group. Notably, some other pupils found the investigation very challenging and asked for a reasonable amount of assistance from the staff: these pupils might have found greater benefit had the activity been more teacher-led as they struggled to progress to the higher levels of learning encouraged by the investigation format of the activity. A third group made very slow progress, spending a disproportionate amount of time on the early stages of the investigation, and so spent little time attempting the marked questions. It was this group that therefore produced some of the lowest scores, appearing to lack the motivation to work through an multi-stage task requiring a variety of skills for a reasonably extended period.

The survey of attitudes does not necessarily reflect the diversity of responses seen as there was once again little alteration in the students' reported perceptions and attitudes after the extension class. The level of this activity was higher than the initial one but the students were not given the impression that they were being tested on the material (work was returned with comments but not numerical marks). This removed the potential demotivating factor of performing badly, but simultaneously also acted to lower the motivation of some of the students to complete the activity.

From the first two activities, it is clear that student motivation has a very direct impact on their progress, although not necessarily on their perception of the task. The second section of the project was therefore developed to explore further their choices and reasoning. By giving the option of three activities of equal difficulty but different methods of delivery, it is hoped to gain an understanding of the role choice plays in motivating the pupils as well as seeing the effects of the choices being made by their peers.

Although no assessment was made of the students' performance in the tasks, it was noted that most of the weaker students, who typically struggle the most to maintain focus, chose the computer-based activity; the RI Masterclass activity appealed to the majority of the rest of the class, including all the girls, who seemed to very much enjoy working together as a group. It was somewhat surprising that just three students chose the small-group taught class, but may be worth noting that this group included the two top-scorers from this year's Olympiad. It would be interesting to explore further whether this preference for teacher-led activities was repeated amongst those with high marks on other occasions, even if the perceived level of challenge was

their nominal motivation. The majority of the students were content with their choice of activity although a number of those choosing the Masterclass noted that they found the topic contained some difficult concepts.

These observations should also be placed in the context of the reasons given by the students as having been most significant in their choices. The choices of peers played a major role in influencing the group choosing the computer-based activity and the data suggests that one or two boys, keen to use the computer, took a large group of friends with them.

The Masterclass group show a strong motivation by the topic of the activity which hints at a basic interest in aspects of the subject that can dominate over other factors. Perhaps it is this same interest that caused the perception and attitude data to be little influenced by the first two interventions and betrays a valuable enthusiasm within a significant section of the class that deserves to be nurtured, regardless of whether the individuals concerned are currently the very top performers. It is to be hoped that allowing the free selection of activities, granting the students some autonomy in their learning, did help to promote this goal. Interestingly, over a quarter of the class felt that their chosen activity has benefited them with improved confidence in mathematics which suggests that individual extension activities produce small changes in perception, which are not easily detected on a coarse four-point scale, but have a cumulative effect on attitude to learning. It would be interesting to develop this research further by following these small changes over a longer period of time as further extension work is undertaken.

Proposal

In terms of the specific activities, the first, curve-sketching, was well-suited to that stage of the year and could easily be tweaked to improve the engagement of some members of the class. To some extent, we might need to take a longer term view of the success of the second activity, introducing the derivative, as any benefits of this groundwork may only become visible in assessment outcomes when calculus is returned to formally.

The work to understand the students' motivations confirmed a good number of ideas that on-going observation of the group had suggested and some of the peer pressures that exist within it. Questionnaires were used rather than a focus group in order to keep the quantity of data manageable, but perhaps the quality of the feedback suffered as a consequence. Interviews with a focus group would certainly have allowed for

additional perspective to be gained in more complex areas such as how the motivation and perspective of the girls varies from that of the boys and would be a useful way to develop this research further, along with the other possible areas for development suggested both previously and below.

Conclusion

In summary, the students' perceptions of mathematics seem remarkably robust to the experience of individual extension activities, instead reflecting the totality of their experiences of extension to date. Inevitably, perceptions and attitudes are influenced by many external factors and the students' wider background. The time scale of this research is perhaps therefore rather too short to see any significant impact from the extension programme as a whole. It might be more useful to look at the on-going progress of the set, for instance in terms of the number going on to A-Level Further Mathematics and beyond, although disentangling the role of Year 9 extension in this would become very challenging.

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人大附中西山学校“1对1数字化学习”案例

人大附中西山学校 — 金政国老师, 林杉老师, 王建伟老师, 李欢老师

人大附中西山学校是中国第一所开展“1对1数字化学习”项目的公办完全中学；第一所也是唯一一所被认证为“苹果杰出教育项目学校（Apple Distinguished Program School）”的公办完全中学。

人大附中西山学校全校园覆盖无线网络，开展“1对1数字化学习”的班级师生每人配备一台苹果笔记本电脑，利用1对1数字化学习技术来发掘全新的学习方法，现在已经成为了师生共同的乐趣所在。英语课上使用iMovie拍摄和剪辑新闻播报，让学生可以大声练习口语；音乐课上利用GarageBand制作原创乐曲；在中文课上，学生使用电脑撰写博客文章，在线分享作品和素材。他们还利用Keynote等应用软件向全班展示作品。部分学科的老师开始尝试运用iBooks Author来制作动态iPad教科书，丰富的3D图像和音频、视频内容吸引学生投入自主探究……借助苹果平台上的教育软件和工具、社群媒体网站的学习平台以及移动学习设备，人大附中西山学校正在开展学生全情参与、高效互动、实时反馈的学习活动探索，目的是帮助学生在获得学科知识的同时，提升批判性思维、协作能力、沟通能力、媒体素养、创造能力等21世纪技能。

一、内容创作

iPad作为移动学习的工具进入中小学课堂,受到广大师生的喜爱和家长的认同。iPad具有携带方便、屏幕大、电池续航能力强、屏幕反应灵敏、软件多且设计人性化诸多优势。学生不用再背着沉重的书包上学,人手一台的iPad就是一座移动的图书馆,里面有海量的学习资源可以利用。但现成的资源在内容设计上或多或少有一些缺憾,不能做到“量体裁衣”、“对症下药”。解决办法唯有教师根据学生实际开发相应的教学资源。

地理教师崔登才是一位善于创造的老师。崔老师利用自己多年教学积累的视频、音频、图片等素材资源，使用苹果开发的软件iBooks Author进行整合，自己设计和制作电子书,使原来只有静态学习图片的课本，变成了生动直观、模拟实际生活情境的可交互学习平台，并以此作为进行iPad移动学习的工具。借助图库、视频、互动式图表、3D物体、数学表达式等丰富内容，学生们可以更清晰地理解实际情境中的问题，地理学习由此变成了一种充满乐趣的自主发现的旅程。目前崔登才老师已经建立了与自己教学课程相配套的电子书资源库，使这样的教学方式常态化。

Timeline 3D是一款极具创新意义的软件，它可以帮助用户创建漂亮的3D时间轴事件。在历史课堂上，林杉老师依据最新的课程标准，尝试创新，将时间作为线索，通过罗列重要历史事件，帮助学生利用Timeline 3D创建属于自己的个性化“教科书”，每名学生都可以制作出包含图片、视频、音频、链接等具有丰富材料的独一无二的历史大事年表。在学生探究的过程中国，老师负责提供思考支架，进行问题解决的思路指导，并在学生进行演讲展示的时候组织评价，以此改变传统课堂教师一厢情愿地给予、学生只能被动接受的弊端。

二、应用模式

根据1对1教学的“三原则”：个性化、移动性、情境泛在性，人大附中西山学校不同学科的老师们都在进行1对1课堂应用模式的探索。

1、朱荣老师的物理课

在以往的物理实验课中，因为时间和空间的限制，每个实验小组只能了解本组的实验过程，很难了解其它小组的实验过程，所以群体之间的互相借鉴很难实现。而老师也由于分身乏术，无法充分了解每个小组的实验进程，难以开展对实验方法的全程关注与指导。利用iPad，朱荣老师创造性地将1对1教学的模式引入实验室。以《飞机为什么能上天》这节课为例，朱老师在实验环节中让每个小组进行相关的模拟实验，使用iPad进行拍照，记录每个组的实验现象，并上传到在线网络平台，通过在线的网络平台，教师和学生都可以进行实时反馈，并通过点评每个组记录的实验现象指导实验方法。这样一来，每个小组不但能够了解自己实验中的问题，更能了解其它小组的实验过程，使许多“稍纵即逝”的实验现象被保存下来，成为大家共同的学习资源。

2、王建伟老师的科学探究课

科学探究课并不是一门国家课程，而是王建伟老师自2010年开始，通过对数字化传感器在科学课程中的应用进行整合实践，并参考美国的科学课程、新加坡的科学课程、国内的科学课程，在专家指导和学校理科组老师们不断切磋改进下，将数字化技术运用到科学课程中的首创。目前《数字化科学探究》课已经是人大附中西山学校的校本必修课程。王建伟老师在教学过程中，将iPad作为数字化学工具，利用Finger

Piano，Graphical，DataAnalysis，iTeach，DocAs，iThought等软件，进行采集数据、分析数据、模拟仪器、提交作业和测试评价。每一个学习任务中，王建伟老师都会先指明学习目标，讲解学习过程，提出学习要求，然后指导学生分组探究，同时通过在线网络平台上传分析得出的实验结论，进行探究结果的展示。通过这样的探索学习，学生经历了团队合作、问题解决的过程，体会到发现的快乐，爱上自然科学。

3、李欢老师的生物课

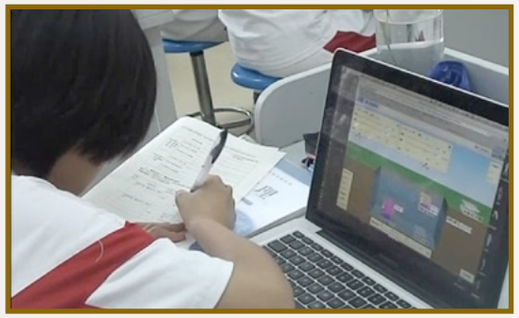
在初中，生物课是一门实践性和体验性都非常强的课程。许多年后，学生们或许很难记得什么叫结缔组织、心脏里有四个腔室等等，但是他们会深刻记得曾经接触的那些活生生的东西，会记得羊腿骨肌腱与骨骼附着是如此牢固，会记得鼠妇在光下逃窜进暗盒的样子……但生物实验课堂有一个弊端所在——或者说是其魅力所在，那就是因为生物实验材料的差别而导致的实验现象和结果的不确定；由于时间的限制，也很难保留实验前的现象，从而在实验后进行对比分析。因此，生物课堂上，图像和视频的及时、有效分享便显得尤其重要。李欢老师利用iPad和在线网络平台，让学生们将本组实验前的现象和实验后的现象进行拍照记录，每组的实验现象上传至在线平台，并实时连接至大屏幕向全班分享，从而使得实验前后的对比分析以及实验现象的及时有效记录成为可能，增强了学生对于分析方法的理解，提升了21世纪技能。

4.金政国老师的数学课

数学是一门研究数量关系和空间形式的学科，也是一门培养学生问题解决能力的学科。在数学课上如何能够让学生对于空间形式经历实验、观察、发现的过程，从而通过合情推理猜想结论，一直是学生推理能力培养的重点和难点。传统的教学中，往往由于教师同时面对多个学生，很难对学生在自主探索、合情推理的过程中进行有效的、个性化的指导，使对于结论的探索变得非常困难，学生更多的是被动地接受了结论，而不是自主发现。不过，在金政国老师的数学课堂中，探索过程已经变成了学生自主发现的过程。以《勾股定理》一课为例，根据教学需要，金老师制作了富含各种媒体素材的文档，通过网络平台传给学生，学生在自主探究的过程中，利用模拟真实情境的

图片进行拼图，当遇到困难时，可以点击教师预先录制的音频，并可以自主选择三个不同层级的提问录音进行提示，从而帮助自己在合情推理的过程中突破难点。老师在学生探究的过程中，不断巡视，及时发现问题，及时反馈指导。最后，还可以通过网络平台对学生进行个性化的学习效果检测，因为网络平台的便捷性，学生可以在完成必答基本题后选择选答提升题，而即使是学习能力最强的学生也可以在提交答卷后点击自动提升的网址，链接到维基百科，从而进行更广阔和深入的探索。

5. 张志标老师的物理课



物理是一门非常重视实验的学科，而物理上的定性研究和定量研究也是实验中非常重要的研究方法。以张志标老师的《浮沉条件》一课为例，在传统教学中，学生可以通过实验进行定性研究，发现物体浮沉的现象，却因为操作的难度，很难实现对物体漂浮、悬浮时重力和浮力的数值的定量研究。张志标老师运用一款模拟软件，在学生实际操作实验进行完定性研究后，又通过软件探究物理在漂浮、悬浮时其浮力和重力的之间的数值关系。通过这样的探究，学生可以在模拟情境中学习到分析问题的方法。

三、专业发展

针对教师在1对1教学专业发展方面的需求，人大附中西山学校未来学习项目组以TPACK的框架推进教师培训，目前主要有两种形式：一种是以学生主导培训的方式培训教师使用软件、平台等工具，从而提升教师的技术素养，也为教师对于技术和教学法的整合提供了可能性；另一种开展“打靶课”，教师综合运用TPACK进行一节课的课程设计并进行“打靶”。所谓“打靶”，即某一位老师将自己的一节“1对1数字化学习”模式的课程作为公开课，在课前备课、说课、磨课，实际授课和课后反思、评课的各个环节都面向所有教师开放，大家围绕学科本质和1对1教学要求共同讨论，共同提升团队学习力，打磨1对1教学功力。这样而来的“1对1数字化学习”模式才是极具生命力的，因为它源于并一直生长于现实教学的土壤。

为了与更多探索“1对1数字化学习”的同行交流，人大附中西山学校与美国普纳荷学校、新加坡新科技中学建立了“三国三校”协作项目，开展定期的学生与教师互访，相互学习和分享在未来学习方面的探索成果；与北京多所国际学校组成了“苹果杰出教育工作者培育计划（Apple Distinguished Educator Program）”社群，并于每年11月在西山学校举办“1对1教学探索@西山国

际峰会（1-to-1 Teaching & Learning Exploration @ XISHAN International Summit）”。第一届峰会已于2012年11月23日至25日成功举办，第二届峰会将于2013年11月22日至24日举办。

人大附中西山学校希望成为中国“1对1数字化学习”项目的卓越中心，通过移动学习平台与教学内容、教学方法和教学评价的整合，为每个学生创造个性化学习的大环境，实现“培养具有21世纪技能的人才”的使命。

打开一扇通向原野的窗子
——谈课堂教学中的空白艺术

上海市第三女中中学, 语文组 — 刘芸老师

中国古代文论中极力推崇“无言之美”、“无声之美”，它的实质是指艺术意味所必需的可以引发千般想象的模糊与空白。譬如中国画墨色盈动，水韵诗意，几笔淡墨轻岚旋即勾连出一幅大写意作品，以形写神，引领观者进入旖旎超然的艺术空间中。同样诗歌以“言有尽而意无穷”的精炼语言给欣赏者在吟诵时留下许多的空白。这些空白让读者在想象的王国纵情驰骋，体会言外之旨、象外之意。可见，艺术是以迂回曲折的方式来打动人心，它反映生活完全不是对现实的摹拟。尽管艺术世界响彻着现实世界雄浑的回声，但声音中分明有着自己独特的旋律。因为在艺术与现实之间站着艺术家。艺术家通过有限的“形”的表现，达到对无限的“神”的传递。

这些都是接受美学的理论体系关于文学艺术作品审美欣赏的一个概念，即“空白”的艺术。在教学中是否也该讲究“空白”的艺术呢？一些知识功底深厚，教学细腻扎实的教师每一堂课都紧针密线，精心雕琢，为学生扫除一切障碍，其教学效果有时也许不及那些大刀阔斧，简约粗犷，充分相信学生的教师。认真分析起来，恐怕后者就是在不自觉中运用了“空白”的艺术吧！严格地说教学上的“空白”指的是教师在教学中有意识地对教学内容、教学时间、教学空间所设置的不明确式、切割式、精简式措施。利用“空白”艺术进行教学，其目的在于充分激励学生更加主动的学习和发展。

怎样在教学中讲究“空白”艺术呢？下面谈谈自己在教学中的尝试。

其一、集中兵力，直接围攻，提供争鸣的空间，诱发学生勤思。

《梦游天姥吟留别》这首诗融神话传说、自然山川和诗人的切身体验为一体，运用丰富奇特的想象和大胆的夸张，创造了新奇深邃的艺术境界，寄寓着诗人奔放激越的感情，充分展现了李白诗歌充满的理想色彩和浪漫激情。

完成本文的教学工作之余，我也有了更多的实践体会。内容安排上，要抓住重难点，“集中兵力，直接围攻”。优秀的作品，可学的东西很多，但教师必须大胆取舍，每一节课，每一篇课文都应该重点突出，详略分明。

在这首诗中，我把感受李白豪放飘逸的诗风、把握李白傲岸不屈的个性作为重点，集中精力组织学生进行突破。由于李白的诗以前接触的较多，他的诗风学生有所了解，所以我设置了一道鉴赏题安排为自主性学习，重在引导学生自己去感受。把握诗歌情感和诗人精神不仅是个重点，更是难点。处理时，我把它分成两步，首先研究李白的梦境，然后体会梦醒后的长叹。这两个重点约花去35分钟。课堂内容相对集中，给学生一个更明确的目标，给予充裕的思考时间，鼓励学

生运用自己的想象力对作品的情景、语言反复读、深入读。学生个性化阅读有利于学生更积极投入到学习过程中去，能有效的提高40分钟的效率。

教学过程中，学生认知水平、思维特点、个性差异等都会给教学带来不确定因素，诸多的不确定性决定了课堂的开放与生成。所以设计教学过程时一定要预留空间，让学生潜心品读、静心思考。教师要尊重学生的个人独特感受见解，引导学生调动自己已有的知识储备、经验储备，多角度、多层次地体悟文本所涵盖的意义。不能只顾自己的喜好来强加学生，影响他们的独立思考。这就是叶圣陶先生所说“教师之教，不在于全部讲授，而在于相机诱导”吧！

其二、传授知识，巧留“空格”，训练学生自己打天下。

精确的分析能让学生容易接受教师所讲的知识，然而过多过细的讲解，往往使学生容易产生厌烦、依赖的心理。嚼烂的食物还有多少余味呢？所以我在上传统篇目《马克思墓前的讲话》时，就采用了先将课文第一段作示范，精讲了何为“关键词”，如何点划关键词句、如何寻找承递性关键语句：“这个人的逝世，对于……”“不仅如此。”“一生中能有这样两个发现……”“他作为科学家就是这样，但是……”“因为马克思首先是一个革命家。”“正因为这样……”指导学生从整体上把握文章结构，学会举纲张目。之后将课文余下的部分交由学生自己设疑，相互质疑。　　在比较中蓄势，在梳理中领悟。课堂气氛顿时活跃起来。这种给学生“喂粗食”的方法，不仅加深了学生对课文的理解，而且还培养了学生自读的能力，使学生相对地摆脱各种客观条件的束缚在自主和自由的王国中探求美、感受美、观赏美。其效果远甚于教师将自己对课文的理解原原本本地灌输给学生，使学习像白开水，一眼见底，一饮而尽，或许可以解渴，但喝完也就完了，没能“授之以渔”。理想的审美状态应该是怎样的呢？ 老子通过对自然生命的观察,认为人类最理想的状态是纯任“自然”和“无为”。“自然”与“无为”是二而一的主张。在老子看来,“无为”并非无所作为,而是要“善为”。“善为”的关键就是顺其“自然”,即按事物本身的内在规律去适当作为。人只有在顺应自然规律的情况下才能达到自己的目的。所以，传授知识，巧留“空格”，排除形式化的流程，让学生和文本之间进行更为深入的充满智慧的对话。这是对语文学习本质的一种回归，是学生自身主动意识的一种彰显。

其三、教学巧设 “空白”，以虚生实，感受画外意境。

阅读在教学中是一个重要环节，教师如果能很好的指导阅读，并在关键时刻不失时机地在阅读后留下“空白”往往能收到意想不到的的效果。我们知道，优秀的作品都有美的意境，这是作家在作品中创造出来的一种韵味、一种氛围。意境审美可以帮助学生从作品的表层进入作品的深层，并由此获得自己的领悟。

如果教师善于巧借艺术审美因素，营造意境之美，学生自然会展开联想，受到情感的感染，情操的陶冶，进入课文的佳境，去领略文中的意蕴，无需授课者将自己的审美经验转述给学生。

比如许多古诗词和现代优美散文，教师可以借助配乐朗诵的手法，必然增添情趣，加深理解。朗诵《水调歌头·明月几时有》配上二胡名曲《闲居吟》，平稳的节奏，如歌的旋律，末段极慢板的曲调，道尽了作者安闲孤寂的心态和无眠思亲的惆怅，在美妙的音乐中朗诵真让人身醉其中不舍归。柔缓的二胡声仿佛把我们带回到了北宋年间那个夜晚，皎皎婵娟、依依杨柳、萋萋芳草，师生们一同走进了苏轼的心灵世界，一道体悟他思念胞弟的手足深情和那浓烈的乡愁。东坡居士吟诵着“但愿人长久，千里共婵娟！”从他心底生发出的真诚声音，让我们深切感动。这是从失意矛盾中走向胸怀坦荡的达观的文人，留给后人的温暖与美好，慰藉着千年来普天下不得意与离恨的人。我们并不用精讲课文，睹月——怀人，再自然不过的情感发展。如此洋溢着的人文之美，何须老师在那动情“引导”。

可见，语文教学课堂充满张力，我们不要去压缩她的空间，而应最大限度地去拓展她。只有如此，才能把她的效益最大化，才能把她的美挥洒得淋漓尽致。

当然，课堂中“空白”的效果，决不是疏漏和残缺，它是课堂教学追求的一种至善至美的艺术。我国历来有“云中之龙”、“雾中之花”的说法，讲的就是艺术传达上的“模糊”与“朦胧”。这也是空白艺术留给欣赏者无穷的乐趣和深刻的哲理。但是“云中之龙”总还要让人看到、感到、想到是“龙”；“雾中之花”也总还要让人看到、感到、想到是“花”。如果一切全归于“无”、全归于“空白”那还有什么学习、欣赏的必要呢？既然是艺术，那它决不是耍聪明，玩花招。要创造课堂的空白美，对教师自身的修炼就提出了更高的要求。课堂教学过程是教师、学生、文本这三个生命体的对话和思维碰撞过程，从这个意义上说，课堂的进程具有不可预测性。如何有效激发并合理面对课堂生成，把教师、学生和教材等优势资源进行整合，得到最大程度的开发，这是最考量教师的地方。教师的教学机智乃至教学智慧，集中地在这个地方体现出来。因此教师必须加强课后反思，经常审视分析自己的教学行为，充分发挥自己教学的优势领域，激活学生的优势智能，并促进其向弱势领域渗透；教师还要善于开发课程资源，用适宜的方式拓展讲授内容和探究活动。只有这样，教学的最佳功能才有可能显现。

据说先哲苏格拉底从不给学生现成的答案，而让学生自己通过探索去作结论，睿智的贤人做了极好的示范。正如著名的教育家苏霍姆林斯基说“有经验的教师往往只是微微打开一扇通向一望无际的知识原野的窗子”。给学生充分的思维驰骋的空间，给学生以欣赏、信赖的目光，相信我们的教学课堂将成为充满生机与活力、达到一种虚实相映、疏密有致、有张有弛，富有情感与诗意的课堂了。

激活课堂，点燃学生的物理小宇宙

上海市第三女中中学, 物理组 — 严自律老师

教师在教学工作中一定会花大量的精力于“教学设计”。也就是传统意义上的“备课”。在教育新理念下，人们对教学功能的认识不断完善，对教学过程中诸多相互作用要素的认识越来越深刻，越来越感到教师仅仅靠经验为基础的备课与教学活动，已经跟不上现代教育的要求和发展。在以人为本，协调全面可持续发展的科学发展观的引领下，如何做好一名教育理论转化为教学行为的设计师，化学生被动接受为主动吸取知识成为大家都关注的一个问题。关键在于培养学生的学习兴趣，激发学习动机。

现在的课堂有的时候给人的感受很压抑，严厉的教师在课堂上给学生灌输知识，学生带着一丝惶恐坐在下面用力的听着，记着，也不敢发问，更不敢交流。久而久之，学生的面部表情越发严肃，思维习惯日益僵硬，性格也愈发拘谨、内敛。如果一直这样下去，教师的确还是传授知识的，但也就仅仅是知识而已，学生通过这样的载体所获得的能力的提高也是杯水车薪，且是低层次的。

所以激活课堂，化学生被动接受为主动学习是我们迫在眉睫的任务。记得我们学校有位数学老师给我们分享过这样的经验：他在上到“复数”的时候，正好学校的语文老师给他看了一片语文课本上的文章，名为“说数”。语文老师主要是来请教一些这篇文章中涉及到的数学内容。没想到这位数学老师看了之后大呼文章错误百出，劝这位语文老师不要教授这篇文章以免混淆了学生数学上的知识。并答应由自己来给学生上这篇语文课文。这样的“混搭”一看就很有意思，果不其然，在一堂数学课上，一篇语文课文成为了重要的素材。而学生学习的方式就是来找这篇文章中的数学错误！学生听到这样的任务，积极性一下子被调动起来，没想到代表“权威”的课文文章也会犯下跨界带来的错误。整堂课都在一种非常积极、兴奋、主动的环境中展开。学生越上越来劲，直到下课了，还继续相互讨论、琢磨。这次经验的分享给了我很大的启发。其实小孩子都有对新鲜事物好奇的天性，动动脑筋，多多留意这样的契机来改善学生的学习方式会起到很好的效果。学习如果是在这样的土壤中生根发芽，那必将枝繁叶茂。

当然物理与其他学科不同，物理学科概念多，抽象思维深刻，应用范围广泛，学习活动复杂，如何激发学生学习物理的动机成了理顺教学关系的重要环节。学习动机是由相互制约的学习需要和学习期待共同组成的，学习需要是认知需要的一种是马洛斯的需要层次理论中成长需要的最基本的需求，可以长时间推动人从事满足这些需要的行为。这对物理学习是相当有帮助的。认知需要是在主体感受到认知不协调，新老知识发生冲突的情况下自然生成。因此我们要了解学生，并善于顺着学生的思路挖掘、设计一些能呈现出让主体认知发生冲突的问题，这样就能很自然的调动起学生的学习热情。在具体实施中可以从几个方面着手。

首先，物理是一门实验科学，很明显的能够感受到，学生在丰富有趣的实验面前是很难抵挡这门学科的魅力的。富有真实、直观、形象和生动的实验常常出乎他们的意料之外，认知得到了冲突，兴趣开始盎然。通过动手操作可以满足他们操作的愿望，更重要的是通过与物理的亲密接触，感受到了实实在在的物理现象，体验到物理规律正在起作用，从而增强学习愿望。所以教师不仅需要自己去做实验，而且要设法让学生动手做实验，鼓励他们用实验的方法来验证一些生活现象，并从中体验快乐。

在学习高一物理“气体定律的应用”这一节内容的时候，有大量的与生活实际相联系的趣味实验可以让同学们感受物理的神奇魅力。记得当时我给同学们准备了用水浸泡过的土豆片、一根去了笔头的圆珠笔芯管、一根刚好能够穿过芯管的细铁丝，就这三样东西能够组成一个自制小气枪。方法就是将芯管的两端分别扎入土豆片后拔出，就会在两头管内留下土豆做成的小塞子。然后将细铁丝其中一端内的土豆塞子迅速往管内一顶，另一端的土豆塞子瞬间就转变成了小炮弹，以极快的速度向外射出，形成“气枪”。这个实验的原理也非常简单，两端的土豆泥将管内的空气与外界大气隔断形成封闭气体，迅速挤压其中一段，内部封闭气体的体积猛然减小，压强陡然增大，最终将前端的土豆片射出。

当时同学们非常喜欢这个小实验，在课堂上玩的很愉快，从脸上的表情就能明白，他们的愉悦之情并不单纯是低层次的玩枪，更重要的是他们亲自感受到了物理原理的用途。用身体感官来理解物理原理的方式，即让他们觉得有意思，也因为有了内在的学习驱动而享受到轻松学习的乐趣。

其次可以在教授学生学习新的知识，新的概念的时候，补充一些当时发现这个物理规律的过程或故事。把当时科学家们如何通过努力来解决认知上的冲突也完完整整的呈现给学生们，让他们体会物理学家们的执着和精妙的思维。让看似冷冰冰的物理规律显得丰富一些，饱满一点。很多规律的发现是很曲折，很富戏剧性的。例如法拉第当时发现电磁感应现象的过程，前前后后历经10年，也做了很多现在看上去很好笑的事情。比方说为了避免干扰，将线圈和电流计放在两个房间里，当把磁铁放置在线圈中，马上跑去另外一个房间看电流计指针的变化，显然是不会有任何结果的。

故事如果是通过感性的方式，让物理原理有个有血有肉的载体依托，那么所有原理获得的来龙去脉，就成了一种逻辑感极强的理性方式，这样学生就不会觉得概念的出现是突兀的，是要死记硬背来应付考试而已的。例如牛顿的万有引力概念的获得。其实很多老师教授这节内容的时候会讲那个牛顿被苹果砸到的故事。但是这显然不能激发起学生的兴趣，因为这太过经

典，学生都能娓娓道来。牛顿发现这个规律像牛顿第二定律一样，不是直接就得到了一个表达式“F=ma”“$F=GMm/R^2$”，都只是阐明了一些物理量的正比关系。具体的表达式是通过后人的一些规定和实验才最终确定下来。但是牛顿当初得到万有引力定律的思维过程是非常有闪光点的。先是通过苹果的下坠结合牛顿第一定律联想到：如果月亮没有朝着地球掉落的话，它将会做直线运动，最后则会脱离绕地轨道，所以他认为月亮正绕着地球运动，确定了不断改变月球运动状态的力正是地球给月球的引力。随后又根据地月检验、开普勒三定律与牛顿第二定律结合得出万有引力与质量成正比，与距离的平方成反比。最终通过牛顿第三定律——力的作用是相互的，来确定万有引力是与两个相互作用的物体的质量的乘积成正比，完成了万有引力规律的建立。这样教授知识，学生才能信服，才不会觉得莫名其妙，才能学到物理的海洋中去。

即使是在高考压力迫在眉睫的高三，也能够做到激活课堂。高三学生的知识储备已经有了一定的积累，教学手段也允许更加灵动。对辨析思维的要求较高一高二有明显的提高。比较、归纳、提炼是学习的主轴，学生可以从这个过程中体会到将书越读越薄的成就感。所以无论是学生的知识准备程度还是这个阶段的学习特点，都已经让学生成为课堂的主角成为可能，老师应该甘当配角。

从我自身的教学经历来看，09学年第一次任教高三，在上课之前我往往在思考怎么才能把问题讲清楚，怎么去对习题进行分类提炼，把教师自己的经验用语言来传授给学生。现在想来，这样一年下来，我的收获比学生多多了。然而要参加高考的不是我，而是她们。课堂的目的是要让学生获益，而且是要尽可能的让各个层次的学生都有不同程度的提高。

因此我觉得应该要让学生自己动起来。勇于把自己的错误奉献出来，表达出来。同时善于聆听同伴的思路，找出问题，提出自己的想法。要能敢于表达，我觉得民主的课堂氛围至关重要。教师是课堂的主导，节奏的控制权应该牢牢掌控在自己的手里，但是发言权，甚至是犯错误权应该适当的交由学生。让任何学生都在一个没有后顾之忧的“安全”的环境中，尽情的表达自己的想法。无论对还是错，只要有价值，就是正能量。所以在课堂上，我往往会挑那些发生有价值错误的学生上台把她的想法展示出来。因为学生了解我的教学习惯，而且不仅从我的语言还是眼神她们都能感受到这是善意的教学手段而已，所以上台的学生虽然明知自己是在表达错误的想法，也完全没有任何不好意思或怯场。在作必要的准备后都能做出完整的表达。这样一来台上的学生处于应激状态，思想高度集中。底下的学生，层次高的在积极帮忙寻找错误的根本原因，层次较低的也在对错误产生共鸣后，激发兴趣，高度期待之后的纠正。因此较好的效果有两种，一个是台上的同学自己在讲解的过程中，通过底下的“七嘴八舌”，自己已经了解到错误的根源，立即再把错误进行修正。另一个就是台下的同学提出错误的原因，上台把正确的想法再演绎一遍。最

后老师做好点评和提炼以及对上台的同学表示认同和赞许。这样的课堂学生不被动，老师不吃力，氛围民主轻松，但思维紧张高效，一节课不知不觉就过去了。一个学期下来没有一个学生不曾上过讲台，物理课上的就像是一个论坛一样，你一言我一语，大家各取所需、并肩前行。我觉得教师在这个教学过程中，起到的作用就是一个引领者，什么样的错误是典型的有价值的错误；学生的表现哪里可圈可点、哪里尚有不到位、不规范的地方都是老师要思考判断的。

激活课堂是一个非常好的理念，然而也不能机械化理解或套用。教学是一个非常复杂的人与人交流的过程，不同的对象，不同的内容，处理的方式孑然不同。理科也应该不失顺畅严谨的推理过程和教师作为主角时的娓娓道来。怎样的时机适合怎样的激活方式，更待我们在课堂中琢磨。

用理性审视的目光看待这个世界
——论针对女生特点的批判性思维的训练

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批判性思维是英语Critical Thinking的直译。Critical Thinking在英语中指的是那种能抓住要领，善于质疑辨析，基于严格推断，富于机智灵气，清晰敏捷的日常思维。这是一种摆脱简单的线性思考方式的思维，要求思考者秉着公正心态来评判身边的人和事，对世界做出合乎公正的评价。

高中女生表现最明显的就是感性思维远远大于理性思考。她们情感丰富，感性认识强，思维敏感细腻，关注细节，更富于幻想，易于被作品、生活中充满人性的人物、悲剧性的情感甚至是细微的动作所感动、被吸引，也会因为丑恶的现象而忿忿不平、情绪激动。所以她们的直接感受往往影响了她们对外界事物的客观、冷静判断，甚至可能被信息的汪洋大海所淹没；被各种似是而非的解决方案所迷惑；被他人别有用心的真实谎言所误导等等。而且，对她们来说，要抓住中心思想和议题、判断证据的准确性和可靠性、判断推理的质量和逻辑一致性、察觉出那些已经明说或未加明说的偏见、立场、意图、假设以及观点、从多种角度考察合理性、在更大的背景中检验适用性、评定事物的价值和意义、预测可能的后果等等，这些往往是她们的薄弱环节。如果能在课堂中增加批判性思维的引导，相信对于她们理智判断复杂多变的世界，提升现代社会生活的人文精神有着必然的重要性。

一、以教材为突破点，努力增加批判性思维的引导。

教材是最直接最有效的范本，在论说文的教学中，我们不妨通过梳理行文结构，把握具有衔接作用的连词，思考论据是如何充分为论点服务的等环节来增强逻辑思维的训练，来增强逻辑推理和演绎推理的能力，关注思维的真实性、精确性、意义和价值。比如在教学鲁迅的作品《未有天才之前》时，就可以以其缜密的结构来显现其严密的逻辑思维能力。这是1924年鲁迅关于文艺创作问题的一次演讲，首先，鲁迅先生指出目前文坛存在的现象和问题——文艺界对天才的呼声很高，正说明了现在天才的缺乏，他认为就中国目前的现状来说，与其要求天才的产生，不如先踏踏实实地做培育天才的泥土。接着他深入分析了当时社会上存在着比缺乏天才更严重的问题——扼杀与阻碍天才产生的种种现象，如“整理国故”“崇拜创作”“恶意的批评”等。最后，鲁迅先生发出倡导，希望大家都能来做“泥土”，为天才的产生做一点贡献。为此，他还提出了一些具体的做法，如容纳、了解天才，甘于做小事情，创作、翻译、欣赏甚至消闲都可以，只要不做那戕害天才的事情就好。这样来看本篇演讲的结构严密明晰，有利于听众很快抓住问题的核心，把握听讲的内容。此外，我们还可以提出进一步的思考问题，“作者呼吁人们做泥土，和当时文艺界呼唤天才是否矛盾？”同学思考后就会明了，这是不矛盾的。当时不具备天才产生的社会条件，作者认为“做土的功效，比要求天才还切近”，是更急迫要解决的问题。再者，大家都有了做“泥土”的愿望和行动，才能改造适合天才成长的社会环境，天才自然会从“泥土”中产

生。如果对于这样的论说文我们能多从整体思路出发对女生进行思维的训练和引导，久而久之就能教好地培养她们大局观，从整体出发，增强逻辑思维的严密性。

在散文教学中，我们也可以通过引导学生的理性思考来进行批判性思维的培养。比如在教学《瓦尔登湖》时，我们的选文选择的是《湖》这一章节，大多数是停留在对于写景描写的赏析上，最多还有就是大工业革命对湖造成的破坏引起的反思。但是当我们细读《瓦尔登湖》后，就会发现作者入住瓦尔登湖，并非只是为了逃避社会，寄情山水，而是进行一种实验，寻找一种从未有过的简单的生活体验。工业革命给社会带来的喧嚣使得梭罗选择了瓦尔登湖，为了使得伴随工业文明和科技发展而来的纷繁复杂的社会生活变得简单，梭罗选择蛰居瓦尔登湖，是为了寻求他心中的真理，为了保留他的思想。正是在这个意义上说，作者笔下的湖水，村庄，他心中的法律，头顶的天空，都有着特定的象征意味。作者走近自然，观察自然，正是体验一种从未有过的生活，实践人类伟大的精神，即宇宙精神。美国语文教育教材{1}选择《瓦尔登湖》第二章“我生活的地方，我为什么生活”，以及作品的结束语。第二章一开始就讨论梭罗购买了生活的地方，并介绍梭罗对财产所有权的选择，他生活目的是什么，它还考验我们，对生命而言，如何成就更出色的自己。这两部分虽然也有对自然的观察与思考，但重在说理。在这里我们不妨引入美国教材的选文及注释和练习，比如在作者介绍里，从三个方面介绍梭罗：（1）肯定他对权威的挑战勇气，通过简化自己的需要，梭罗得以把自己的下半生都奉献给对人类和自然之间的精神联系的探索和写作，并用以支持自己的政治和社会信仰；（2）在瓦尔登湖畔：介绍梭罗蛰居瓦尔登湖的时间、目的，揭示《瓦尔登湖》的思想价值；（3）梭罗与墨西哥战争：介绍梭罗反对政府发动的墨西哥战争，表明美国人对历史事实的客观态度和对自由精神的颂扬。这样对《瓦尔登湖》及其作者的思考就可以完全定位于“人类精神与自然世界”，这样使得学生对作品的理解建立在人类精神的高度上。通过这样的解读，可以使我们的女生不仅仅停留在描写细腻，多角度写景抒情的层面，而是增加了一种全面理性的思考。

二、以作文为激活点，努力提升批判性思维的思考。

批判性思维也是我们在作文教学中努力提倡的，我们可以通过作文训练激活学生思维中的“火花”，倡导她们要公平公正合理看待社会某些现象，要学会辩证的一分为二的思考问题，要敢于表达自己独特的观点，让个体进行独立的判断与选择。

比如，有这样一则材料：美国首富、微软公司创始人比尔盖茨宣布：在他约185亿美元的财产净值中，他将只给孩子们每人留1000万美元，剩下的将捐献给慈善事业。美国第二大富翁沃伦巴菲特也已经放言，他的子女将很难得到他的巨额财产，他说：“那种以为只要投对娘胎便可

一世衣食无忧的想法，损害了我心中的公平观念。”68岁的美国住宅装饰公司董事长伯纳德马库斯说：“遗产对有些人来说可能是可怕的负担。如果我的孩子想成为富翁，他们必须依靠自己努力。”他把8亿多美元的财产全部留给支持教育和残疾人事业的马库斯基金会。　请以《我看美国富翁不给后代留遗产》为副题，任选一个角度，写一篇800字左右的议论文，题目自拟。通过材料的提示，要求从父母教育孩子如何看待财富的角度入手，可以探讨公平竞争的价值观的培养；培养孩子必须依靠自己的努力具有获得财富的能力等等。如果没有这种客观辩证的思维能力，我们的学生在理解上就会有失偏颇，比如理解为“遗产是可怕的负担”、“接受遗产就会让你毫无退路”、“钱是万恶之源”，中国遍地都是“富二代”的不劳而获等等。很明显，这些学生的理解是片面的，这也是她们思维狭隘、不会理性、批判性思考问题的结果。

在一个好的批判性思维者身上，我们能看到她们深刻的分析、严密的推论、流畅的表达，从而达到自我校准、自我反省，做到了思想公正、透彻、客观、尊崇真理和合理性。一个不会批判性思维性的人，是不具有质疑精神和创新能力的人。一个只会以反面和否定的眼光看待问题的人，是个思维简单容易陷于狭隘的人。这也是我们通过作文训练应该努力达到的。

三、以生活为检验点，努力追求批判性思维的应用。

教育，作为一种最主要的社会引导，体现为一种价值引导。教育是有目的和方向的；教师作为人类文化的代言人对学生的成长负有道义上的责任。价值引导主要体现为在教育中蕴涵着教育者的价值选择与预设。对于学生而言，受教育者是一个有自由意志、人格尊严的、自主的个体；受教育者的心智与个性是其在社会性交互作用活动中能动地生成的，任何外在事物的意义必须经过受教育者的主观理解才能变为他自己的经验。

在日常的训练中，我们可以有目的地引入时事点评，进行有价值的引导，让我们的女生通过个体体验，更具有理性的逻辑思考的能力，更具有批判性思维的意识。比如我们选用了《流氓化场景下的言论境遇》的一篇时文，要求同学在“时评”中用双横线划出论点；用序号标出论据，注明论证方法；梳理论证层次结构，理出结构表；自选一个角度发表评论。我们还给同学就一个事件的不同评论，比如熊丙奇的《“国学天才”为何进不了复旦》、宋石男的《如果“国学天才”只是一个神话》请同学辨析后谈谈赞成哪方观点并陈述理由。批判性教育的目的就是个体必须具有独立的评判能力，以便能够评价现有文化中什么是真实、有意义的和有价值的。通过这样读报剪报的训练，其实也是让女生学会面对各种扑面而来的信息、各种可选的解决问题的方案以及他人的不同意见，做出适当的评价。

另外值得辨析的是批判性思维，不是思考负面的影响，只寻找错误，而是对某件事情做出明智的思考和判断，以至于评价者的言行与客观的评价相一致，使之做出的评价尽可能是正确的。批判性思维，应该是一种敢于质疑、敢于否定、敢于提出自己的见解的思维，与此同时，它也应该是一种讲理由，重依据，讲分寸，用科学公正的态度对待问题的思维。希望通过教师有意识的启发引导、激活训练，能够让我们的女生在这方面有更长足的进步。

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赏析，领悟，习得
——在经典英语的阅读中培养女生的语言综合运用能力

上海市第三女中中学 — 韩毓音老师

著名美学家、教育家朱光潜先生曾经说过：“文学就是语言的艺术……在任何一国要找真正好的语言，大半都要从最好的文学作品中去找。”由此可见，对于英语学习者而言，阅读经典的文学名著无疑是提高英语水平和培养人文素养的有效途径。

一、激发阅读兴趣，培养自主性学习

经典的英语文学名著为英语学习提供了有效的语言输入和语境接触。运用已有的英语知识顺利地读完一本小说，必然能给学生带来成就感，并让她们体会到学以致用的快乐。

尤其是我校的女生，对文学有着与生俱来的好感。一旦兴趣被激发，她们会投入百分百的阅读热情，在欣赏文学作品的同时潜移默化地输入语言。

根据Krashen的输入理论，他认为单纯地主张输入是不够的，学习者需要的是 “可理解输入”(comprehensible input)，这样，他们的内在加工机制才能够运行。即输入必须包括“i+1”。如果习得者目前的语言能力为i, 那么，语言输入需要略高于i, 即i+1，而且这种i+1的输入必须在意义上是可以理解的。

“输入假说”还强调,语言使用能力不是教出来的,是随着时间的推移,通过接触大量的可理解输入之后自然形成的。可理解输入是习得语言的关键。

鉴于此，我们在去年的高二年级推行了英语简本小说的阅读，希望学生能够在优秀的小说中“习得”语言，而不是传统意义上的“学到”语言。

我们之所以选择简本小说，主要是考虑到简本小说是在原作的基础上对其语言进行了再加工。我们的教学对象是高二年级的学生，她们的词汇量只是在3000左右。倘若一下子就让她们阅读原著，过多的生词会成为极大的障碍，影响她们的阅读热情。而简写本词汇量适中，句子结构简单，语言难度不高，具有很强的可读性。另外，简写本兼备了原著的思想内涵、文化底蕴和写作风格，是极佳的语言范本和人文教育素材 。

于是,在过去的一个学年里,学生们得以遨游在文学的海洋。Jane Eyre 和 Rochester 曲折的爱情经历以及 Treasure Island 中各色人物为了财宝而互相勾心斗角的故事无不给学生留下深刻的印象。

美国著名文学家海明威说过：“作品有如冰山，露在水上的只有八分之一，其余的八分之七

隐藏在水下。”可见，学生对阅读小说产生兴趣只是成功的第一步。引导她们感知和赏析小说是更为重要的任务。我们要求学生先理清故事的线索，从整体上感知小说。在了解环境和情节的基础上，体会小说的主题，概括人物的性格。

起初，学生只是觉得Jane Eyre和Rochester有着一段不平凡的感情，但在几个问题的启发下，她们对故事有了更深层次的思考。What qualities of Jane attracted Rochester? Why did Jane still choose to marry Rochester when he was no longer rich? Why do you think Jane Eyre is a classic? 通过对这几个 open questions 的回答，简爱独立坚强、不向命运低头、敢于追求平等自由的人物性格就变得栩栩如生了。

二、促进听说读写，实现语言的内化

英语的听说读写是四个重要的技能，它们相辅相成，缺一不可。在平时的教学中，通常对它们是单独分开训练的。但经过一段时间的实践，我们发现经典小说的阅读其实可以同时促进这几种技能的发展。

根据现代认知心理学理论，广义的知识可以分为两大类:一类为陈述性知识(declarative knowledge), 另一类为程序性知识(procedural knowledge)。陈述性知识是用于回答“世界是什么”的问题。程序性知识是用于回答“怎么办”的问题，是关于如何进行某种特定的认知活动的知识，是运用概念和规则解决问题的知识。那么，英语小说的阅读恰能帮助学生实现语言的内化，促进学生陈述性知识的学习与保持，帮助学生实现程序性知识的程序化，培养学生的语言综合运用能力，并从一定程度上改变高考的阅读基本局限于选择题，主要考查学生的认知能力的教学策略。

我们尝试了影像媒介与小说文字“共读” 的方式。Jane Eyre 是一部女性作家的经典之作，不管是 Charlotte Bronte 的文字，还是 Joan Fontaine 的传神演绎，都极易引起女生的共鸣。学生不仅领略了作家文字的优美，还在欣赏影像艺术时进行看、听、读的融合统一，即看表演，听对话，读字幕。小说的文字版与影像版之间形成了相互补充、相互促进的关系。而在这个过程中，学生实现了知识的程序化，从小说文字版中获得的陈述性知识，如词组的搭配等，在影像媒介中得到了巩固，并在观看后的讨论中得以灵活运用。

说，是我校女生英语学习中比较擅长的环节，这得益于平时坚持不懈的训练。虽然，口试成绩只是作为高考的参考分，但我们从未放松培养学生的英语口头表达能力，尤其是以“读” 促“说”。例如，在阅读小说Love of Life之后，我组织了课堂辩论，一组学生认为 In such a difficult

situation, it is understandable that Bill abandoned his friend.；另一组学生则持相反意见 。一番唇枪舌剑之后，学生对小说的主题有了更深的了解，对生命的涵义有了全新的认识。

写作一直是学生的薄弱环节，高考英语作文25分，全市的平均成绩仅在13分左右。内容空洞、词汇贫乏、语法错误、中式英语……学生需要改进的地方非常多。有些同学会说，平时我的阅读量不小，可为何做不到“读书破万卷，下笔如有神”呢？如何能改变从阅读到写作的脱节现象呢？从经典小说的阅读中汲取养料，无疑是一条捷径。这些小说内容丰富、结构紧凑、主题鲜明、语言规范，所有这些都为学生提供了可欣赏、可模仿的素材。本学期，我们要求学生在阅读教师选取的作为范文的章节时，放慢阅读速度，认真做好摘记，摘录精彩的词、句和修辞手法，然后反复诵读，加强记忆，为今后的写作积累经验。

三、注重情感参与，强调非智力因素

语言教学是个需要情感参与的过程,因此我们在对学生进行经典小说阅读指导时将学生的非智力因素放在了重要的位置。

心理学研究表明，学生在学习活动中，有两大因素在发生着作用。一类被称作“智力”因素，它包括一个人的记忆、思维、想象能力等；另一类被称作“非智力”因素，指一个人的情感、兴趣、意志、性格等。非智力因素发展得好，智力因素才能够得到更好的发挥，非智力因素是提高学生智力与学习效果的关键。

基于此理论，我们在本学期取消了上学年所采用的小说阅读测验环节，代之以open questions，并辅之以课堂讨论和交流，藉此降低学生的学习焦虑感，增强她们的学习动机，提高学习自信心。这样的改变，学生普遍觉得容易接受，否则一边欣赏优美的小说，一边惦记着明天的测验，效果肯定不理想。

前苏联著名教育家赞可夫曾经说过：“教学法一旦触及学生的情感和意志领域，触及学生的精神需要，这种教学法就能发挥高度有效的作用。”在课堂讨论中，由于事先已经有了open questions 的铺垫，学生真正做到了畅所欲言。当然，教师也应起到一名组织者和监督者的作用，一旦有学生的发言偏离主题，就适时以启发式的问题把她们拉回“正轨”。对于学生的精彩发言及时表扬，而对于那些相对口语薄弱的学生则给与更多的鼓励，并允许她们在语言上犯一些错误。

例如，在阅读 Jack London 的 Love of Life 时，我们为学生设计的问题之一是：How do you

understand the title? 学生的回答颇具想象力，字字句句无不迸发出思维的火花。He survived because of his love of life. What's more, the author intended to arouse the readers' awareness of keeping the balance of nature. We should learn to care for every living creature, including grass, fish and wolves.

可见，结合英语学科的特点，在小说阅读中提供给学生宽松而积极的氛围，不仅能激发学生的发散思维，而且有利于学生积极参与，自主探索，在潜移默化中提高语言综合运用能力。

英语经典文学名著的阅读在学习语言的同时，也为学生打开了一扇了解外部世界的窗。在增加阅读量的同时，她们也能够开阔视野，陶冶性情，提高自身的素养。在得到良好的文化艺术熏陶的同时，她们的探究能力和解决问题的能力也得到了提升。

The use of Microcontrollers in the SST Curriculum

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Microcontrollers such as Arduino and Raspberry Pi devices are increasingly popular teaching tools used in the curriculum. The School of Science and Technology, Singapore (SST) is actively infusing these devices into their Investigative Skills in Science (ISS) module as part of student's exposure to Applied and Industrial Research. In 2013, Arduinos and Raspberry Pis were introduced into the ISS module and the results of the implementation was evaluated. Based on the teacher observations, the student research reports and surveys, we were able to identify a few key ideas. There are implementation issues that needed addressing, such as the issues of training. However, we have also found that students were welcoming of the change and hoped for a more pervasive implementation either within subjects or as a standalone subject by itself. These devices offer the students an opportunity to adopt a more hands-on approach towards learning such as constructing devices through circuit making and basic programming.

Key words: Arduino, Raspberry Pi, Microcontroller, Applied Learning, Applied Research

1. Introduction

SST is a specialised independent school set up by the Ministry of Education Singapore to cater to the needs of the 13-16 years old who are interested and talented in the areas of Science and Technology. The mission of SST is to "Develop World-ready and Future-looking Leaders through Innovative Technology and Applied Learning" (SST, 2013). Specifically, SST aims to train their graduates in a distinctive way such that there is emphasis on both the technology as well as pedagogy.

1.1 Applied Learning

The applied learning pedagogy guides SST teaching and learning process so that the curriculum is delivered within a relevant real-life context. This is to ensure that learning experiences are coherent, challenging and aimed at developing the full range of student capabilities and talents. (SST, 2013) which is in line with the current emphasis of the Ministry of Education on Applied Learning (MOE, 2013). In a recent press release, MOE emphasised that "the Applied Learning programme will serve to connect academic knowledge and skills with the real world". It further elaborated that "the emphasis is on the application of thinking skills, connecting knowledge across subject disciplines, stretching the imagination and applying these in authentic settings in society and industries" so as to "help students appreciate the relevance and value of what they are learning in the academic curriculum and develop stronger motivation and purpose to acquire knowledge and skills" (MOE, 2013).

1.2 Applied Learning Curriculum in SST

Within the school, a strong emphasis has been placed on the use of Applied Learning for the academic programme. Applied Learning is pervasive in all the learning in the school. It covers both content as well as pedagogy and involves the formal to the informal curriculum.

From the content perspective, our Upper Secondary (grade 9-10) students are given the opportunity to be able to study an Applied Subject offered by the polytechnics. They include Biotechnology, Fundamentals of Electronics, Design Studies, and Media Studies. These courses are offered as part of the National Ordinary Level curriculum for students.

From the pedagogy perspective, all the academic subjects adopt the six facets of Applied Learning when designing the curriculum. During the evaluation and review of curriculum, all the teaching materials and approaches are evaluated in terms of the six facets of Applied Learning.

Within the formal curriculum, the school has made provisions for a module in Science to incorporate an Applied Learning component. In particular, the students would take 5 science modules in Lower Secondary level and 1 module on the applications of science through the Investigative Skills in Science (ISS) module. In the ISS module, students put their learning into action by suggesting their own project to be carried out as a capstone task. The students are allowed to choose whatever research topic that they want to do for this ISS module.

In the informal curriculum, the school also offers co-curricular activities that adopt an Applied Learning approach. In particular, the Science and ICT talent development programmes (TDP) were set up in 2012 to cater to the needs of talented students in the areas of Science and Technology. The Science TDP was to cater to students who like to tinker with hardware while the ICT TDP was to cater to students who like to tinker with software systems.

1.3 Makers Movement

Libow (2013) claims that the Maker Movement is a technological and creative revolution underway around the world. The Maker's Movement overlaps with the natural inclinations of children and the power of

learning by doing. Embracing the lessons of the Maker Movement holds the keys to reanimating the best, but oft-forgotten learner-centered teaching practices. This makes the Maker's Movement a suitable approach to reinvent our education. Ironically, this is what students learn best at when they are young. The traditional school has ignored this tool and replaced it with the didactic approach, which may cause the students to loose interest in learning.

According to Libow (2013), the general lessons learnt from the Maker's Movement included: (a) "Doing" is what matters; (b) Openness; (c) Give it a go; (d) Iterative design; (e) Aesthetics matter; (f) Mentoring defies ageism; (g) Learning is intensely personal; (h) It is about the technology; and (i) Ownership. These skills highlighted fall nicely in place with the 21st century skills, which place emphasis on critical thinking, creativity, communication and collaboration. To achieve these goals requires taking a hard look at both what we teach and how we teach.. The Maker Movement offers lessons, tools and technology to steer a new course to more relevant, engaging learning experiences for all students (Libow, 2013).

The Makers movement is gaining popularity in US schools (Roscorla, 2013). Superintendents and teachers are trying to make it pervasive such that no students will be denied the opportunity to "make" or "tinker" with tools and materials. The Makers Education is a grassroots process and not a top-down mandate from the ministry of education. The districts (in US) provided the support for teachers who are interested, but each school and teacher will decide what making things will look like in their own classrooms (Roscorla, 2013).

Hence, the Makers' Education is still an unformalised curriculum which has yet to be incorporated into the mainstream education. The current situation offers many opportunities for educators alike to explore the unchartered terrain so as to create new possibilities.

1.4 Arduino

The Arduino (2013) can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). Arduino projects can be stand-alone or they can communicate with software running on a computer (e.g. Flash, Processing, MaxMSP). The boards can be built by hand or purchased preassembled; the software can be downloaded for free. The hardware reference designs (CAD files) are available under an open-source license, where anyone is free to adapt them to suit their needs. The

Arduino can be considered as a cheap data logger and micro-controller, which can perform the functions of most commercially available microcontrollers but at a fraction of the price.

1.5 Raspberry Pi

The Raspberry Pi (2013) is a credit-card sized computer that plugs into the TV and a keyboard. It's a capable little Personal Computer (PC), which can be used for many of the things that a desktop PC does, like spreadsheets, word-processing and games. The Raspberry Pi also plays high-definition video. It is a useful device for kids to learn programming at the simplest level. As a standalone computer, which has size (small), energy consumption (low) and cost (low) advantages, it has the potential to be used as a long term monitoring device instead of a full size computer.

In this paper, we will refer to Arduinos and Raspberry Pis as the devices. Although Arduinos and Raspberry Pis are different devices, they share some similarities such as low cost, portability, simple to use, and have potential for implementation in the curriculum.

1.6 Research Question

The motivation for the use of these devices in SST curriculum was motivated from students rather than the school or teachers. The students, being more aware than the teachers in technology related devices, first initiated the Arduino as a possible platform for engineering projects in the ISS module as well as in the science and engineering competitions. In particular, a student used the Arduino for the ISS module, for a science competition, and for an engineering competition. Although the standard of the project was average, it has brought awareness about the possibilities of Arduino in SST curriculum.

Motivated by the capabilities of the Arduino, we started the mass procurement of Arduinos in 2013 for various programmes. In particular, we purchased more than 90 units of these devices units (66 Arduino units and 27 Raspberry Pi units) over the last year for the Applied Learning-based ISS curriculum.

Our research questions would be as follows:

- What are the key observations of the students' learning using the devices?
- What are the advantages and disadvantages of the devices as platforms?
- What would students like to see in the use of the devices in the curriculum?

2. Methods

2.1 Research Context

This study involves 18 Secondary 2 SST students in Singapore involved in a research module, the Investigative Skills in Science (ISS). This study employs the employment of the devices in their project work as tools to achieve their research aims.

2.2 Participants

The 18 participants come basically from three classes involved in 6 different project tasks. The details are found in table 1 below. Coincidentally, there was only 1 girl in the group from S2-07 working on the temperature sensor for the fish tank. The higher number of boys in the groupings could be due to the higher interest in engineering projects amongst the boys.

Class	Project type	No. of students	Project Title Development of a:
S2-01	Arduino	3	haze sensor and air filter
S2-04	Arduino	4	solar-powered automatic house
S2-04	Arduino	3	pH sensor
S2-04	Arduino	2	soil moisture sensor
S2-07	Arduino	3	temperature sensor for the fish tank
S2-07	Raspberry Pi	3	solar flares detection system

Table 1. Projects involving the use of Arduinos and Raspberry Pis

Two middle school teachers (one physics and one biology teacher) conducted the ISS lessons on research methodology, helped the students with the report writing and managed the safety of the students in the lab. The physics teacher teaches the classes S2-01 and S2-04 and provided guidance to the students in areas related to their project. Occasionally, he may provide guidance to the S2-07 students when they make the request. In this way, there was a fair level of supervision and guidance for all students.

2.3 Design of the ISS programme

The ISS programme lasted for a period of 10 weeks commencing in July and ends in early September. A total of 4 official hours are spent on the ISS programme per week. However, students are allowed to work on the project after school hours under the supervision of the lab staff and also at home. As these devices are portable, the students could have easily brought them home to work on after school hours. Assessment of the ISS module takes place at the end of the 10 weeks for their project. The students are assessed on a set of rubrics on the various components of the research project. Table 2 shows the various sub-tasks, their respective marks, and respective skills assessed for assessment.

Component	Weightage	Skills involved
Group Research Proposal	20 marks	Proposal writing skills
Abstract and Introduction	10 marks	Research report skills. The content for the report is based on an individually chosen project that the students choose to work on. They may also use Arduino or Raspberry Pi for the project.
Methods	10 marks	
Results	10 marks	
Discussion and Conclusion	15 marks	
Bibliography	5 marks	
Log Book	10 marks	Note taking skills
Blog Page	10 marks	ICT skills
2-minute Video	10 marks	ICT skills
Poster	10 marks	Art skills
Peer Appraisal	10 marks	Inter-personal skills
Total marks	140 marks	

Table 2. Components of the ISS module project and their weightages and skills involved

There were some basic training provided to the students on the use of the Arduinos. Students were provided with a 1-hour workshop on the basic installation of the software and connections. Besides that, each student group was provided with a "Sparkfun Inventors Kit", which consists of a self-sufficient set of electronic gadgets and an Arduino UNO board. Within each kit comes with a journal that demonstrates to the students how to set up 14 simple electronic circuits. The students can learn from modelling on how it was done with the other 14 circuits to new circuits of their choice.

For the single group working on the use of Raspberry Pi, there were no specific lessons on how the Raspberry could work. But they were given abundant materials such as a manual on Raspberry Pi, a Raspberry Pi board, and all the necessary electronics and mechanical parts needed to set up a Raspberry Pi computer system running on Linux. Besides that, the students were given contacts of a friend of the teacher (Mr Eric Gilbert) who operates a Raspberry Pi solar flares detection system. Mr Gilbert communicates with the students through emails on instructions on how to set up the system. He was willing to support the students' interest in building a system by sending documents and coding softwares.

Common to all groups of students was a general guidance from the teacher in-charge that should they have any problems with their systems, they could have asked each other, their seniors, and the makers-forum, for any guidance on the intricacies of setting up of the devices. They are given the confidence by the teacher that any help that they received will not affect their assessment as long as they can understand what does the connections and the codes meant.

2.4 Data collection

Data collection for the evaluation of the use of these devices is based on the following methods of data collection as shown in Table 3.

Process	Data source and collection
Classroom Observation	Teacher observation and notes
Evaluation of students' work	Research report (Discussion and Conclusion sections)
Student survey after the project	Students comments on the three main questions posed as a survey: (a) What are the advantages of Arduinos/Raspberries in our curriculum? (b) What are the disadvantages? (c) What are the recommendations from you?

Table 3. The summary of data collection

2.5 Data Analysis

For data analysis, the researchers looked into the data from three different sources: classroom observation, students' report and written reflections. We attempted to understand students' cognitive development process through the projects and tried to highlight recurring themes or trends that the programme designers should take note of in the future through the triangulation of the data from the three sources. The trends or suggestions may lead to a modification of existing practices in the use of these devices.

3. Results and Analysis

Observational data were mainly collected during the ISS programme while written data (reports and surveys) were collected after the ISS programme. These data were presented in the following format in the sub-sections below.

3.1.1 Teachers' observations of the learning process

Based on the teachers' observation, students relied heavily on the existing sources provided by the teacher and new sources provided by others through their searches on the internet. These resources provided the students with a lot of help in completing their projects. Most of the students do not need extensive help from the physics teacher as they were able to clarify their doubts through discussion and internet websites. The level of their confidence as observed by the teacher can be considered to be on the high side.

In one particular case, there was even an interesting intellectual debate that ensued between the student and the teacher in question. The student leader (henceforth referred to as the student) of the group involved in the "Development of a Solar-powered automatic house" engaged in a discussion regarding how the sensing and control devices should be wired in his project. Despite being a novice in the use of Arduino, the student was able to understand, operate and even think at the conceptual level as to how the circuit diagram should look like. Figures 1 and 2 below shows the diagram that he was working on to achieve his final objective.

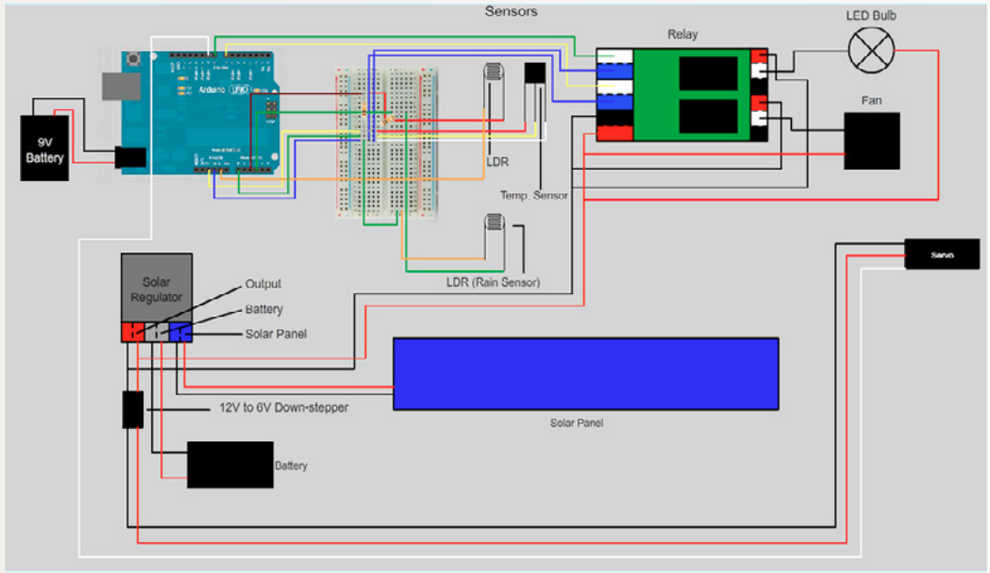

Figure 1.
Circuit diagram of the Solar-powered automatic house.

```
}
void loop(){
  lightLevel = analogRead(sensorPin);
  rain = analogRead(rainPin);
  if(lightLevel < 150)
  {
    digitalWrite(7,LOW);
  }
  else if(lightLevel > 200)
  {
    digitalWrite(7,HIGH);
  }
```

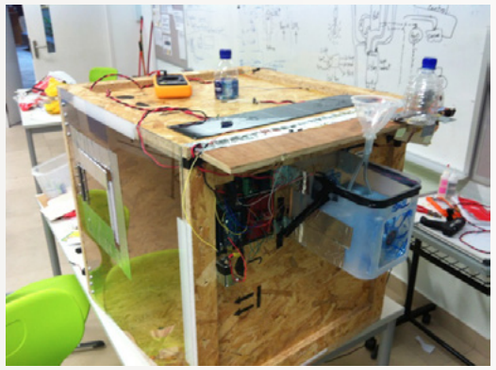

Figure 2.
Part of the programme code and the Solar-powered automatic house.

In the project "Development of a solar flares detection system", the students were able to assemble the Raspberry Pis with the antenna and radio circuits to come up with a working system for data collection. Figure 3 shows how the system is wired up. Although most of the steps in setting up the system was provided by the websites and the adult mentor, the students were basically independent in the development of the prototype.

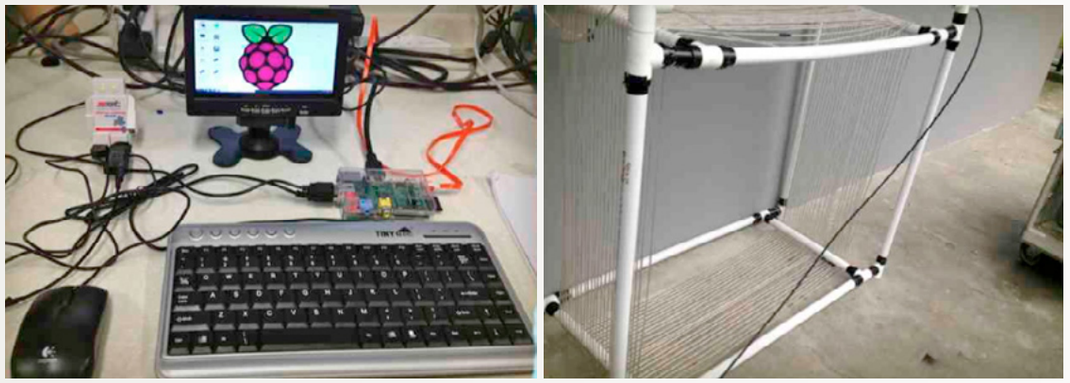

Figure 3. Finished setup of the Raspberry Pi data collection system

3.1.2 Observations from the students' reports

The students' reports are uploaded online in a form of a blog and can be found in the table 4.

Project Title Development of a:	**Project Blog Page**
haze sensor and air filter	http://sst2013-s201iss-e.blogspot.sg
Solar-powered automatic house	http://issgroupbravo2013.blogspot.sg
pH sensor	http://sst2013-s204iss-d.blogspot.sg
soil moisture sensor	http://sst2013-s204iss-f.blogspot.sg
temperature sensor for the fish tank	http://sst2013-s207iss-a.blogspot.sg
solar flare detection system	http://sst2013-s207iss-f.blogspot.sg

Table 4. Blog sites containing the students' report for public access

There were many interesting reflections in the students' report that can be classified into some major themes. They are mainly in the areas of application, limitations and further study that involves the use of these devices.

Students were able to highlight the areas of application of their project to other areas as well as an extension of their project. The confidence was exhibited when they discuss about how they can further apply their projects to new situations:

More antennas could be developed to collect radio signals of different frequency ranges. A more detailed study into lightning could also be conducted. Lastly, we could develop a lightning warning system and weather forecast system in school. (Development of a solar flare detection system)

We can also add in the biometric fingerprint sensor for added security. The person will be able to walk out or in conveniently and the power supply will be cut off to systems like fans and lights when the person is out. (Development of a solar-powered automatic house)

If we manage to get less than 0.1% error, we have decided to extend our project to build a system. We would attach or mount our pH sensor to an aquarium or any other places that needs a pH sensor. The pH sensor will be measuring constantly the value of the pH of the liquid at set intervals of time. If the pH sensor fluctuates drastically and over a limit therefore posing a threat it will play a loud blaring noise and notify others. Following that, the words "BEWARE pH LEVEL HIGH" will pop out on the screen. This will notify other of what exactly is the issue when after then come over upon hearing the blaring sound, giving them valuable time to save their aquarium or projects from harm before it is too late and irreversible damage has been caused. (Development of a pH sensor)

Students were also able to highlight the limitations as in what the Arduinos or Raspberry Pis cannot do, as well as problems associated with its use. Examples include:

We have also learned that the wiring of the different components is very important as one small mistake could lead to malfunction, or worse, a short circuit of the components. (Development of pH sensor)

We felt that for this project, we could have something like a cover to neatly pack the breadboard and all the required materials into it, resulting in a cleaner product in terms of arrangement. The sensors would also not have to be this crude, but we felt it was still doable as it was supposed to be a household product. As for he programming, I felt that we had done exactly what we had wanted it do, just that there are glitches in the display, as some of the unoccupied letters on the display were filled up with squares. (Development of soil moisture sensor)

Students were able to identify areas for further studies. These further studies either made use of the devices at a smaller or larger scale. Examples include:

Measurement of pH has been expanding its scope and is now used in a wide range of situations, from medical to scientific purposes. One such example is that of an Esophageal pH monitoring system has been developed for medical purposes. Gastro-esophageal Reflux Disease (GERD) is a common disease in western countries. In the United States, 7% of the population experiences heartburn daily and 44% at least once a month. Therefore, as a solution, the monitoring system is developed to provide direct physiologic measurement of acid in the esophagus. It is currently one of the most objective methods to document reflux disease, assess the severity of the disease and monitor the response of the disease to medical or surgical treatment. This monitoring system has saved many lives by measuring the acidity in the esophagus earlier before serious, irreversible conditions occur. This acidity monitoring system has benefited the medical industry largely. We could use the Arduino for this purpose. (Development of a pH sensor)

For this project, we could use the Arduino for a fully automated plant watering system. We could placed the soil moisture sensor at the base of the plants and link it up with an Arduino. (Development of a soil moisture sensor)

3.2.1 Advantages of Arduinos and Raspberry Pis

Students were able to highlight the advantages of their devices in the survey conducted, such as:

"using Arduinos and/or Raspberries give students who are new to the engineering field and the coding field a feel of how these two are". (Jericho)

"we have a more hands way of learning science, which would interest a lot more students". (Jericho)

"we have found out that Arduino is a very helpful tool to help us control and program things. It is lightweight, affordable and has numerous applications". (Zhong Zhi)

3.2.2 Disadvantages of Arduinos and Raspberry Pis

The disadvantages on the devices were mainly restricted to the training and the motivation to use the devices. Examples of these comments include:

There is a need to "conduct some research on how to use them before we can actually start learning or begin our project". Learning "how to use the Arduino might be a huge difficulty especially to someone new". (Jericho)

Learning Arduino "might be seen as a waste of time to certain students who have no interest in it" (Jericho)

3.3 Students' recommendation for Arduinos and Raspberry Pis in the curriculum

Students mainly recommended that the devices should be made more pervasive, which are an indication of the strong support that they have for the use of these devices in their learning. Examples of their statements include:

It isn't just a choice to use it and that everyone should be given a chance to use it. (Jericho)

there could have been more opportunities to use Arduinos, instead of just 1 term of the year, such as integration into Physics or any other Science classes. (Jericho)

4. Recommendations

The recurring themes in the three data sources point towards the following main recommendations:

(a) There should be more extensive training provided in the use of these devices. It can be either done by the teachers or by students who are already familiar with these devices.

(b) The students are capable of problem solving when handling the devices. The responsibility of the teacher is to provide the necessary guidance and logistic support for the students. The guidance could be in the form of direct help from teachers, indirect help from websites, or even help from peers.

(c) There should be more exposure to these devices at all levels instead of just engaging some interested students in the ISS module. These devices could possibly be a catalyst to the development of Engineering as a subject in our classrooms.

Based on the key recommendations that we have developed above, we derived the following possible action plans:

(a) teach students at all levels on the use of the devices
(b) get students to help conduct the lessons
(c) get students involved in Engineering related projects using the devices

Within the school, Arduino and Raspberry Pi lessons can be integrated into the Information and Communication Technology (ICT) and Talent Development Programmes (TDP). Table 5 illustrates to a certain extent the possible exposure that students can have in the use of microcontrollers.

Level	Time Frame	Semester 1	Semester 2
Sec 1	Level Wide	Introduction to programming through HTML and Gamesalad	
	Talent Development Programme		Introduction to Arduino and Raspberry Pi
Sec 2	Level Wide		Introduction to Arduino and Raspberry Pi
	Talent Development Programme	Carry out STEM projects using Arduinos & / or Raspberry Pis	

Table 5: Recommendation of the curriculum

In Semester one, as outlined in table 5, we hope to introduce all secondary one students with basics to programming through HTML and GameSalad in semester 1. The purpose is to introduce the students to general programming concepts so that they can understand in the logic in computer programming, which is an essential skill.

In semester 2, students are identified for the school's Science and ICT TDP. These students would then be introduced to the basics of Arduino and Raspberry Pi programming. The criteria for their selection would be their interest in using microcontrollers in science or engineering projects. The purpose is to give interested students the headstart in developing the competencies in handling these devices so as to support their Science or Engineering Research interest. This is in alignment with reccommendation (a).

In the following year's semester 2, the school would commence the training of programming for Arduinos and Raspberry Pis for the secondary two students in their ICT lessons. The students under the talent development programme would support the teachers in facilitation and support for their fellow classmates. This arrangement is in line with the recommendation (b) that we have highlighted above.

In both the Science and ICT TDP, the students will engage in using Arduinos and/or Raspberry Pis to a full-scale Science-Technology-Engineering-Maths (STEM) project. These projects will require students to make use of these devices in one way or another within the project, either as a sensor, controller or as a monitoring device. This arrangement is in line with recommendation (c), where the devices will make their way into STEM projects.

Beyond the school, we would conduct sharing, either as a teacher-fronted or a student-guided session, to our partners in different schools and in different countries. Through rigourous action research and evaluation, the practices in the implementation of the micro-controllers will be refined over the years.

5. Conclusions

Microcontrollers are here to stay in the educational landscape, as demonstrated by its capabilities, cost and flexibility. By being a useful engineering tool, it has put learning back into the hands of the learner, as they can tinker with it in their investigation of the world around them. SST will continue to experiment with

these devices to stretch the students' creative and critical thinking in their learning. We should continue to investigate the effectiveness of these devices in the curriculum, as they are potential devices that can transform learning both in and out of the classroom.

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