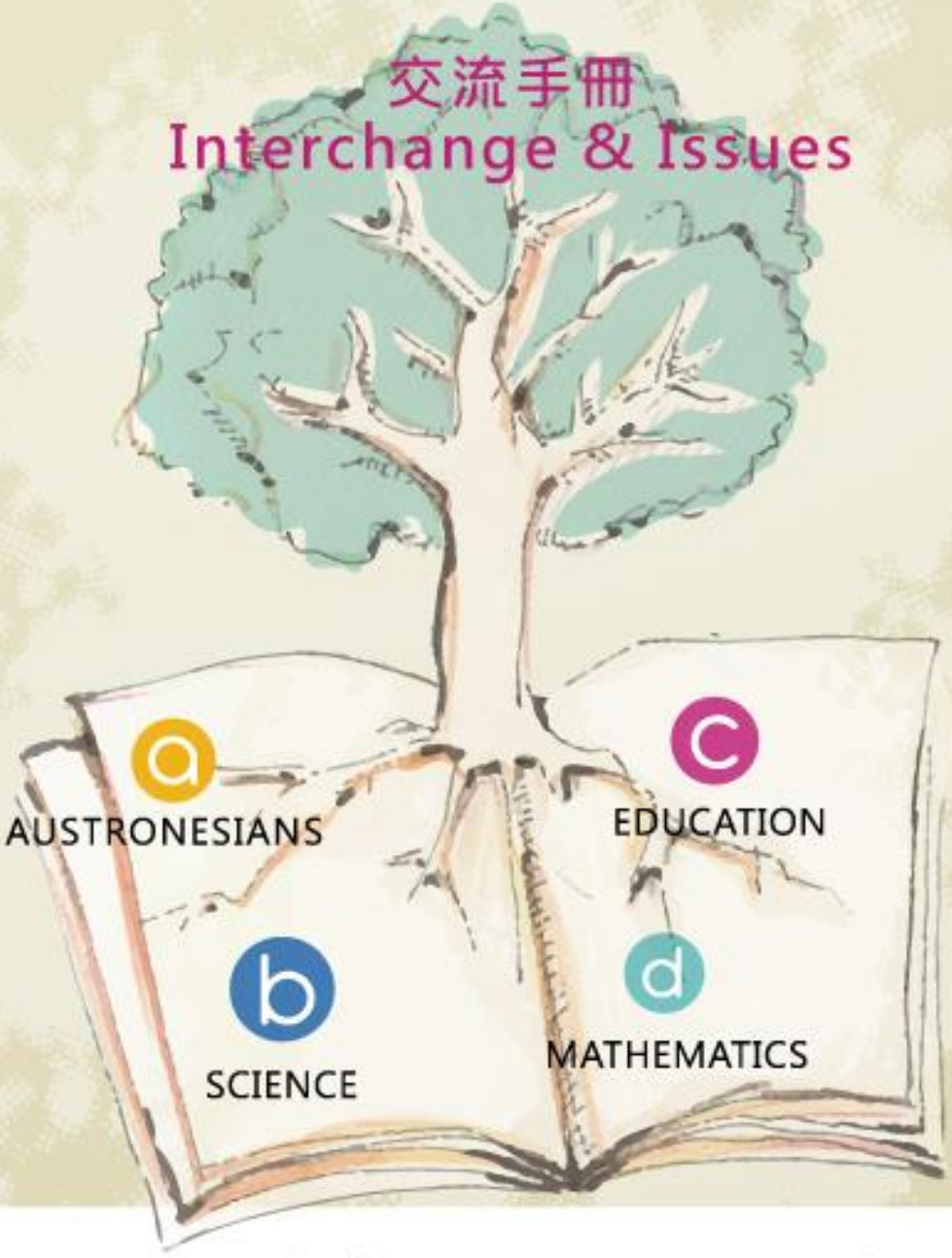
2016年南島民族科學與數學教育學術研討會

The 2016 Austronesians Conference on Science and Mathematics Education

交流手冊
Interchange & Issues



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目 錄

壹、2016 年 11 月 13 日議程表 Program

2016 年 11 月 13 日（星期日）綜合討論與交流合作對談 Symposium **（地點：國立臺灣史前文化博物館 中型會議室）** **Medium-Sized Conference Room, National Museum of Prehistory** 臺東市豐田里博物館路 1 號 1st, Museum Road, Taitung, Taiwan	
時間 Time	活 動 內 容 Activity
09:15~09:30	**報到 Registration**
09:30~11:30	**C：綜合討論與合作對談 Symposium** 主持人：郭重吉講座教授 國立彰化師範大學科學教育研究所 Moderator: Chorng-Jee Guo, Chair Professor, National Institute of Science Education, Normal Changhua University of Education,Taiwan 引言人一/Panelist：熊同鑫教授 國立臺東大學 幼兒教育學系教授兼原住民族教育及社會發展研究中心主任 Tung-Hsing Hsiung, Professor, Department of Early Childhood Education, and Chief of Research Center for Indigenous Education and Social Development, National Taitung University, Taiwan. (Introduction) 引言人二/Panelists：4 位整合型計畫總計畫主持人及個別型計畫代表簡述所屬組別內之研究計畫方向與內容（每人 6~12 分鐘）。 - 汪明輝副教授 國立臺灣師範大學地理學系兼原住民族委員會副主任委員 Tibusungu ’e Vayayana, Associate Professo, Department of Geography, National Taiwan Normal University & Vice President, Council of Indigenous Peoples - 趙貞怡教授 國立臺北教育大學-課程與教學傳播科技研究所 Jen-Yi Chao, Professor, Graduate School of Curriculum and Instructional Communications and Technology, National Taipei University of Education. Taiwan. - 高慧蓮教授 國立屏東大學科普傳播學系(含數理教育碩士班) Huey-Lien Kao, Professor & Chair of Department of Science Communication, National Pingtung University, Taiwan. - 姚如芬教授 國立嘉義大學數理教育研究所 Ru-Fen Yao, Professor & Director, Graduate Institute of Mathematical and Science Education, National Chiayi University, Taiwan. - 林春鳳副教授 國立屏東大學體育系 Chung-Feng Lin, Associate Professor, Department of Physical Education, National Pingtung University, Taiwan.

	引言人三/Panelists：四位國外學者，以簡述個人研究專長，以及近年研究團隊所進行之研究方向與內容(每人 6~12 分鐘)。 - Professor Karen C. Liu, Department of Teaching and Learning, Bayh College of Education, Indiana State University, U.S.A. - Dr. Jyrki Reunamo, Department of Teacher Education, University of Helsinki, Finland - Professor Margaret J. Maaka, College of Education, University of Hawai'i at Mānoa, U.S.A. - Associate Professor Jenny Ritchie, School of Education, Victoria University of Wellington, New Zealand 與談人/Project Principal Investigators： 所有計畫主持人，請以 5~8 分鐘自我介紹，並簡略介紹研究專長與領域 此座談目的，乃期望各計畫間相互了解並形成議題對談，或促成協作可能性的發展。針對有關原住民科學與數學研究本期程的回顧與困境加以分析，期待下一期程方向與願景的建議，或設想國際合作研究的可能性與方式。
11:30~12:30	午餐 / Lunch
12:30	**賦歸 / Closing Remarks**

貳、科技部國合司原住民科學研究第二期計畫分組名冊

序	分組		主持人	執行機關	計畫名稱	地點
1	A	A1	汪明輝 副教授	國立臺灣師範大學地理學系（所）	「魚、山川、海洋」－原住民科學知識與環境教學法模式之探討與建構研究：以阿里山鄒族為例 ：總計畫	臺北
2		A2	樂鍇・祿璞崚岸 副教授	國立成功大學地球科學系（所）	「魚・山川・海洋」－原住民科學知識與學習模式探討與建構－子計畫一：現代環境治理及知識對原住民族居住環境及環境知識傳承發展的影響	臺南
3		A3	沈淑敏 副教授	國立臺灣師範大學地理學系（所）	「魚、山川、海洋」－原住民科學知識與環境教學法模式探討與建構－子計畫二： 以大漢溪泰雅族為例	臺北
4		A4	蔡慧敏 副教授	國立臺灣師範大學環境教育研究所	「魚、山川、海洋」- 原住民知識與環境教學法模式探討與建構－子計畫三：以蘭嶼雅美族為例	臺北
5		A5	王聖鐸 助理教授	國立臺灣師範大學地理學系（所）	「魚、山川、海洋」－原住民科學知識與環境教學法模式探討－子計畫四：匯聚原住民環境知識之自發性地理資訊數位學習平台	臺北
6	B	B1	趙貞怡 教授	國立臺北教育大學教育傳播與科技研究所	原住民學童 CPS 空間概念課程與評量之教學平台發展與建置研究：總計畫	臺北
7		B2	陳珍源 教授	銘傳大學電子工程學系	原住民學童 CPS 空間概念課程與評量之教學平台發展與建置研究－子計畫一：原住民學童數位 CPS 基礎機械概念課程發展與建置之研究	桃園
8		B3	劉傳璽 教授	國立臺灣師範大學機電科技學系（所）	原住民學童 CPS 空間概念課程與評量之教學平台發展與建置研究－子計畫二：原住民學童數位 CPS 自然與生活科技課程發展與建置之研究: 以能源為例	臺北
9		B4	黃思華 助理教授	臺北市立大學教育學系	原住民學童 CPS 空間概念課程與評量之教學平台發展與建置研究－子計畫三：原住民學童數位 CPS 面積與體積五感課程發展與建置之研究	臺北
10	C	C1	高慧蓮 教授	國立屏東大學數理教育研究所	提昇排灣族學童數理競爭力與科普活動之研究：總計畫	屏東
11		C2	陸怡琮 副教授	國立屏東大學教育心理與輔導學系	提昇排灣族學童數理競爭力與科普活動之研究－子計畫一：提昇原住民學童科學閱讀能力之研究	屏東
12		C3	林志隆 助理教授	國立屏東大學資訊科學系	提昇排灣族學童數理競爭力與科普活動之研究－子計畫二：發展與應用數位學習系統縮短原住民數學學習落差之研究	屏東
13		C4	施焜燿 副教授	國立屏東大學應用化學系	提昇排灣族學童數理競爭力與科普活動之研究－子計畫三：以科普活動提昇原住民認識奈米科技新知之研究	屏東
14	D	D1	姚如芬 教授	國立嘉義大學數理教育研究所	雲端數學部落教室—原住民小學數學教材發展與師資培育：總計畫	嘉義
15		D2	陳彥廷 副教授	國立臺中教育大學數學教育學系	雲端數學部落教室—原住民小學數學教材發展與師資培育－子計畫一：原住民小學科普活動的規劃與實踐	臺中
16		D3	賴孟龍 助理教授	國立嘉義大學幼兒教育學系（所）	雲端數學部落教室—原住民小學數學教材發展與師資培育－子計畫二：以眼動技術探究原住民學童數學學習成效	嘉義

序	分組		主持人	執行機關	計畫名稱	地點
17		D4	林志鴻 副教授	國立嘉義大學數理教育研究所	雲端數學部落教室－原住民小學數學教材發展與師資培育－子計畫三：原住民小學數位學習系統之建置	嘉義
18	E	E1	華國媛 副教授	國立臺北科技大學分子科學與工程系既有機高分子研究所	原住民文化融入式健康醫療及環境科學課程與師資培訓	臺北
19		E2	高靜懿 助理教授	慈濟學校財團法人慈濟大學原住民健康研究所	新世紀原住民健康醫療與環境科學教室-傳統知識在健康與環境教育的運用與課程評估	花蓮
20		E3	李俊仁 副教授	國立臺灣師範大學教育心理與輔導學系（所）	建立國小原民學童閱讀能力檢測、學習以及師資培育的數位平台	臺北
21		E4	林春鳳 副教授	國立屏東大學體育學系	原住民族文化回應國民小學非制式化科學教育研究計畫	屏東
22		F	熊同鑫 教授	國立臺東大學幼兒教育學系	扎根與深耕的原住民科學教育資源轉運平台	臺東

參、交流座談各計畫分享內容

A1：「魚、山川、海洋」原住民科學知識與學習模式探討與建構：以阿里山鄒族為例（總計畫）

計畫主持人：汪明輝 副主委[1]

▲研究目標

1. 研發以「鄒族環境知識與學習型態之環境學習與科學教育教材模組」。
2. 推動「鄒族教育工作團」及「sku'u no cou 鄒族語言發展協會」設立，發展鄒族內部建構環境知識的力量。
3. 建構「鄒族教育學模式」。

▲研究方式

1. 以鄒族族語為媒介調查鄒族的環境知識，並建構鄒族關於「魚、人、環境、知識與技能」之知識體系。
2. 透過合作學校執行民族教育課程內容及調查的鄒族傳統環境與生態知識為基礎，邀請「鄒族教育工作團」共同研發以鄒族環境知識與學習型態之環境學習與科學教育教材模組，並研發適宜之教材教法。
3. 與鄒族教育工作團及鄒族語言發展協會成員共同規劃建置「鄒族森林文化學園」的自然學習空間。

▲研究展望

1. 目前原住民族實驗學校、原住民專班等陸續在成立中，在山林空間融入自然及環境教育的議題十分重要，應繼續研發推廣。
2. 未來應在師培教育中推動「原住民族教育文化學分學程」，能培育更多具原住民文化素養的教師，以落實計畫之宗旨。
3. 未來宜持續推動發展「原住民族文化森林學園」，使在都會區的原住民族學童也有機會在自然的空間中，用自己的語言與文化來學習環境及生態知識。

▲各年度工作重點

第一年	1. 進入部落採訪、整理鄒族環境知識及學習型式。 2. 調查鄒族河川環境與鱒魚棲息地之生態概況。 3. 建構鄒族關於「魚、人、環境、知識與技能」之知識體系。 4. 邀請部落族人講述並實作傳統鄒族之捕撈知識。 5. 分析現有自然與生活科技、自然科學、環境教育等課程綱要內容，作為研發民族科學教材之參考。

[1] 國立臺灣師範大學地理學系副教授兼原住民族委員會副主任委員。

	6. 與阿里山鄉達邦國小初步規劃合作模式。
第二年	1. 延續與阿里山鄉達邦國小之合作，也邀請鄒族教育工作團成員，共同研發以鄒族環境知識與學習型態之環境學習與科學教育教材模組，並研發適宜之教材教法。 2. 辦理相關教師之工作坊、研習、試教、討論及教材修正。 3. 繼續進入部落，採集、調查本計畫之「魚、人、環境、知識與技能」之知識體系，俾充實鄒族環境知識及學習型式之採訪資料。 4. 建立 sku'u no cou 鄒族語言發展委員會，並建立網路交流平臺與參與成員互相以鄒語教流本計畫的課程內容設計及活動推廣。
第三年 ｜ 第四年	1. 完成編製鄒族環境知識、技能與學習型式之成果資料。 2. 完成編製適合國中小使用之鄒族環境與科學手冊。 3. 完成「鄒族森林文化學園」的規劃，並在此執行以鄒族為主體所建構的環境知識教學活動。 4. 協助完成本計畫之數位學習平台之建置。 5. 協力完成鄒族與泰雅、雅美等子計畫之比較分析，作為建構原住民環境知識、學習型式與科學教育之模式。 6. 辦理相關學術研討與教學分享，以推廣本計畫之研究成果。

A1: Main Project–Fish, Mountains and Oceans: The Exploration and Construction of Indigenous Scientific Knowledge and Learning Model: A Case Study of Tsou People in Alishan Region

Principal Investigator: Tibusungʉ'e Vayayana[1]

Objectives:

- To develop the teaching module of environmental learning and science education based on *Tsou's* environmental knowledge and learning styles.
- To facilitate the establishment of "The *Tsou* Education Project Team" and "sku'u no cou – The *Tsou* Language Development Society" for empowering *Tsou* to construct environmental knowledge internally.
- To construct the pattern of *Tsou* pedagogy.

Annual project plans:

First year	• To collect and organize *Tsou*'s environmental knowledge and learning styles. • To survey the environment of rivers and the ecological state of Xenocypris habitat in *Tsou*'s territory. • To construct the knowledge system about the relationship of fish, human, environment, knowledge and skills. • To invite *Tsou* peoples to describe and practice *Tsou*'s traditional fishing knowledge. • To analyze the existing curriculum contents of natural and life science and technology, natural science, environmental education and other subjects as a reference for the development of ethno-science textbooks.
Second year	• To continue cooperating with Ta-pang Primary School in Alishan and invite the members in the *Tsou* Education Project Team to jointly research and develop the teaching module of environmental learning and science education based on *Tsou's* environmental knowledge and learning styles and appropriate teaching methods and materials for *Tsou*. • To hold the workshops, teaching demonstrations, discussions and material corrections. • To continue collecting and surveying the knowledge system related to this project "fish, human, environment knowledge and skills" for

[1] Associate Professor, Department of Geography, National Taiwan Normal University & Vice President, Council of Indigenous Peoples, Taiwan. E-mail: t24019@ntnu.edu.tw

	enriching *Tsou*'s environmental knowledge and learning styles. • To establish "sku'u no cou – The *Tsou* Language Development Society" and build the network on the internet for the participation of members in this project to exchange the curriculum design in *Tsou* and event promotions.
Third to fourth year	• To complete the edition of data about *Tsou*'s environmental knowledge, skills and learning styles. • To complete the handbook of *Tsou*'s environment and science for primary to junior high school education. • To complete the plan of "The *Tsou* Forest Cultural Academy" and implement the environmental education activities constructed for *Tsou* People as a subject. • To assist completing the construction of the digital learning platform for this project. • To assist completing the comparative study of the sub-projects of *Tsou*, Atayal and Yami Peoples as a pattern to construct indigenous environmental knowledge, learning styles and scientific education. • To hold related academic seminars and teaching experience sharing to promote our research results.

Research methodology and methods:

- To survey the environmental knowledge in *Tsou* and construct *Tsou*'s knowledge system about the relationship of fish, human, environment, knowledge and skills.
- Through the implementation of ethno-education curriculum by collaborative schools and the survey of *Tsou*'s traditional ecological knowledge, to invite "*Tsou* Education Project Team" to jointly research and develop the teaching module of environmental learning and science education based on *Tsou's* environmental knowledge and learning styles and appropriate teaching methods and materials for *Tsou*.
- To jointly plan and establish "The *Tsou* Forest Cultural Academy" and the learning space in nature.

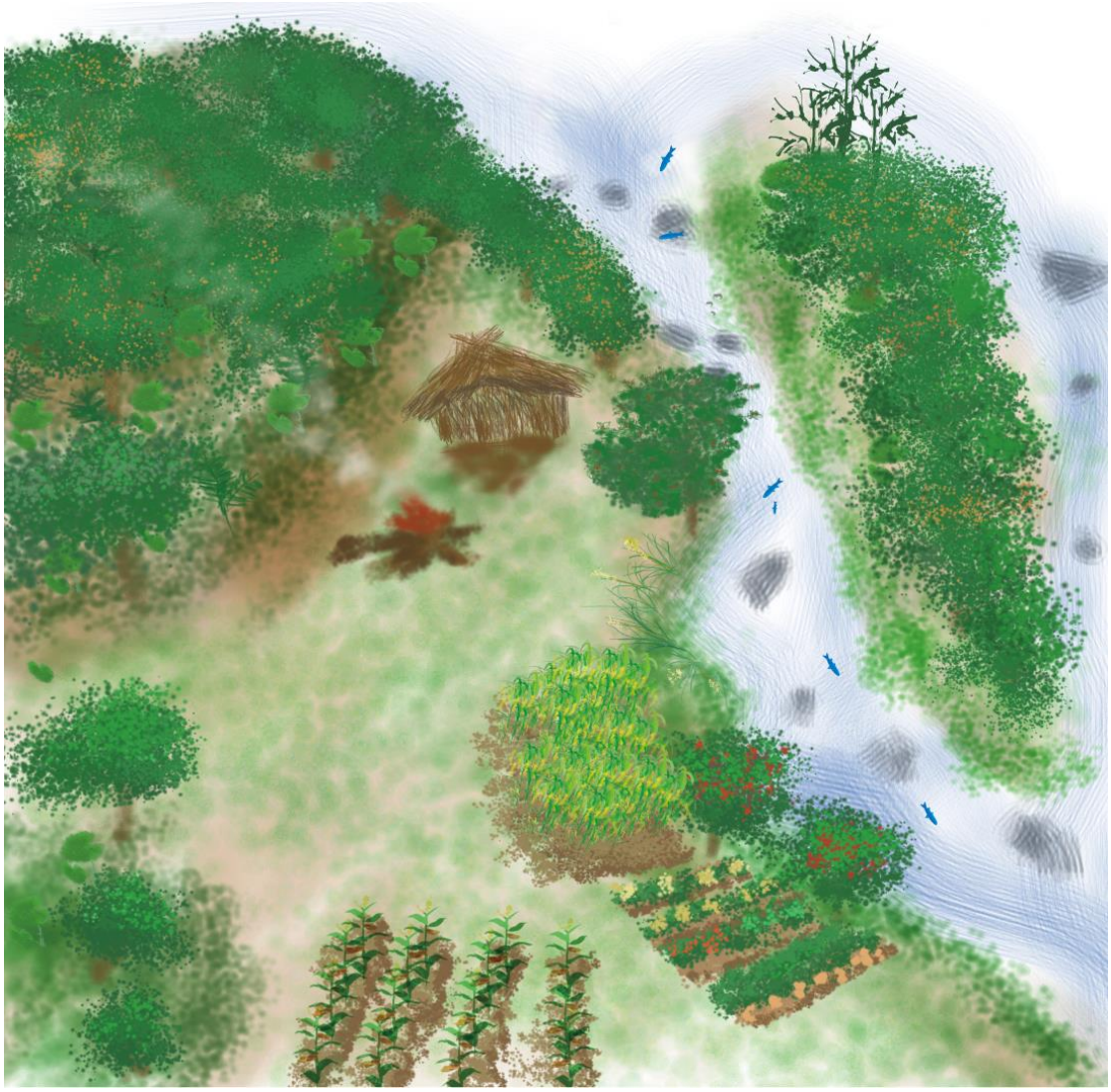
Research prospects:

- More and more indigenous experimental schools and bachelor programs for indigenous peoples have been established in succession and therefore it is important to implement the natural and environmental education in the forests and mountains. We suggest continuing to research and developing this field.
- We suggest facilitating the establishment of degree programs for indigenous education and culture in the teacher preparation education. As a result, we will have more teachers with indigenous culture competence to practice the objectives of this project.
- We suggest continuing to facilitate the indigenous forest culture academies in urban areas. By doing so, indigenous children living in urban areas will have the chance to learn

environmental and ecological knowledge in their own native languages and cultures in the natural spaces.

▲鄒族文化森林學園概念圖

The diagram of "The *Tsou* Forest Cultural Academy"



A2：「魚・山川・海洋」原住民科學知識與學習模式探討與建構
子計畫一：
現代環境治理及知識對原住民族居住環境及環境知識傳承發展的影響

計畫主持人：樂鍇·祿璞崚岸 副教授[1]

一、計畫簡介

本子計畫以曾文溪流域、大漢溪流域及兩溪流域內之鄒族、泰雅族部落為主要田野地，探討現代環境治理方式對原住民族居住環境的影響，以及現代環境知識與原住民族傳統生態環境智慧之間的關係。過去的三個年度工作概要包含調查曾文溪流域之結構物對河川生態的衝擊與沿岸的坡地災害型態，並將這些衝擊對曾文溪流域的鄒族所造成的影響，整合文獻回顧及訪談成果，探討傳統智慧應用於現代災防、選址、農耕生活的可能性；並於大漢溪流域展開田野調查，勘查了石門水庫及中、上游的六座大型攔沙壩、護岸等河工構造物，也透過對該區災害史與部落遷移歷程的爬梳，探討大漢溪流域之泰雅族人面對的環境威脅，同時亦走訪數個泰雅族部落，拜會部落耆老，蒐集傳統農耕、選址、漁獵…等環境知識，將之與 gaga 信仰中的規範、禁忌做對照，最後找出現代環境治理模式在泰雅族之認識論及價值觀中可省思與借鏡之處。本子計畫第四期工作整理於曾文溪流域及大漢溪流域踏查所得結果，彙整部落訪談資料，並參考相關研究文獻，將書寫出具鄒族、泰雅族生態環境知識觀點之教材。

二、計畫成果

水利署認為設置攔砂壩可利於地質穩定，減少水庫淤砂。然而對於興建水利設施時造成巨大的環境破壞，且之後所做的流域整治成效不彰，卻鮮少提及。攔砂壩在興建後使用年限過短，淤滿泥砂後便失去原有功效，並以人工開挖的方式將淤砂清除。若無法清除淤砂，則有可能導致潰壩等更大的生態環境破壞。築壩後生態遭受破壞，無法如整治計畫預期完善地回復環境，也導致漁獲量減少，目前大漢溪流域無攔沙壩的支流生態環境較佳，族人大多於此漁獵。有攔沙壩的支流雖有魚梯等幫助魚類洄游等設施興建，但設計不良以及遭到大水破壞，導致功能喪失。而邊坡的防治工程，大多以鋼筋水泥等人工建材減緩邊坡崩塌，但此工法治標不治本，一旦發生強降雨將會導致邊坡崩塌面積更大。

而從訪談部落耆老紀錄可見，鄒族及泰雅族皆有豐厚的生態環境智慧，無論是防災、部落選址的考量，或農耕、狩獵、漁撈文化中蘊含的永續觀點，都相當符合當今發展潮流，亦可為現代環境治理提供不一樣的思考。檢閱目前國中自然與生活科技教科書，可發現其內容以主流社會經驗、西方科學觀點書寫，因此，本子計畫第四期以實地踏查及訪談紀錄所得資料為素材，亦參照相關文獻資料，編撰具鄒族、泰雅族傳統智慧之教材，以期科學教育更具多元文化觀點。

三、研究困境

從過去文獻資料及訪談資訊可見，原住民族傳統生態知識、環境智慧可視為面對自然的態度及看法，而西方知識則強調經濟效益、工程技術等，並且就空間尺度而

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言，部落少有大規模環境治理經驗，原住民族對環境友善之工法於大尺度環境治理計畫的適用性和原住民族智慧與西方科學知識本質上和分類上的差異，為目前研究上需努力調合之問題，以利未來研究目標更為具體。

此外，由於本子計畫研究跨族群別，資訊量龐雜，以至於分類、統整上有些困難，對於計畫第四期預計完成之教材而言，內容編排不易。

四、未來研究

未來研究目標將更明確，將原住民族友善環境、與自然共存共榮之整體智慧，融合於現代環境治理之工法，並聚焦於特定族群，以期更深入、更完整蒐集資料，讓原住民族環境智慧與現代環境治理知識更有效連結。

A2: Influences of the Modern Environmental Management and Knowledge on Indigenous Residental Environment

Principal Investigator: Ljegay Rupeljengan[1]

1. Introduction of the research project

This project takes Zengwun River and Dahan River as the proper sites for research and also conducts fieldwork in tribes of Tsou people and tribes of Tayal, which are respectively located along Zengwun River and Dahan River. This project works on the influences of the modern environmental management on indigenous residental environment and studies on the relationship between the modern environmental knowldege and the traditional wisdoms on ecology and envrironment from indigenous peoples. In the past three years, the survey on the impact of the structures in Zengwun River on the ecology of the river and the types of riverside slope disasters has been done. Combining the result of the survey with the study references and the information from the interviews of Tsou people, the possibiltiy of applying traditional wisdoms to the modern disaster prevention, site selection, agriculture and so on has been discussed. In order to figure out the environmental threats in Dahan River basin that Tayal people face, the fieldwork has been done on Shihmen Reservoir, six sediment storage dams and some revetments among the upstream and midstream; the study on the history of disasters and the history of tribal migration has also been carried out at the same time. By visiting tribes in Dahan River basin and interviewing the elderly, the traditional environmental knowledges about agriculture, fishing, hunting, residental locations, etc. are collected and compared with the regulations and taboos in traditional belief, which is called *gaga* in Tayal. To do so, hoping that the modern environmental management can have reflection and reference from Tayal people's viewpoint. The last year of this project, it is expected to finish the teaching materials with Tsou and Tayal peoples' wisdoms and perspectives of the ecology and the environment according to the results of fieldworks, the relevant references and the records of the interview.

2. Project results

According to Water Resources Agency, Ministry of Economic Affairs, a sediment storage dam has the advatages of stablizing geology and reducing the silt of the reservoir. However, it seldom talks about the huge destroy for the environment, caused by the process of building these structures, and not to mention the ineffective management of the river basins after the construction was done. The service life of sediment storage dams are usually limited. When the sediment storage dams are full, they need the excavation to clean out the silt or there might be a danger of dam broken, which would cause extraordinary damage of the environment. From the observation of Dahan River basin, the river ecology was destroyed after the sediment storage dams built. It is found that the branches without sediment storage dams have better ecological environment and thus Tayal people usually fish here. Although the fish ladders were built in the branches with sediment storage dams, the inappropriate design or the destroy caused by flood make them lose the functions. As to the slope

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engineering, it usually use reinforced concrete to slow down the collapse, which is just a temporary solution. Once there is the heavy rain, the collapse range of the slope will be larger.

From the records of the interviews with the elderly in tribes, it is believed that Tsou people and Tayal people have abundant wisdoms and knowledges about the ecology and the environment. No matter it is about the consideration of natural disasters prevention and the choice of the residental locations, or the sustainable development viewpoint on agriculture, fishing and hunting, these all fit the current developmental trend and provide good idea for modern environmental management.

And while reviewing the Science and Technology textbooks of junior high schools, we can find that the content is based on the life experience of the mainstream society and the perspective is from western science. Therefore, we are making effort to compile teaching materials according to the information from the interviews, the fieldworks, and also from the relevant references. Hope the education of science and technology can have multi-cultural perspectives.

3. Research predicaments

From the references and the records of the interviews, we can take indigenous traditonal knowlege and wisdom of ecology and environment as the attitude and thoughts toward nature; while western science emphasizes economic benefits and engineering technology. And as for the spatial scale, indigenous tribes has little experience for envrionmental managment in large scale. The applicability of the eco-friendly construction methods from indignous people in large scale environmental management plans is one of the problems needed to be solved. Also, the essential and classified differences between indigenous wisdoms and western knowledges are what should be reconciled in the future study. Last, the research project contains two ethnic groups which makes the information complicated. There is some difficulty to categorize and integrate the materials and make it well-organized in the textbook.

4. Future research

In the future, the research objective will be more specific. Combining the integral wisdoms of indigenous peoples on nature and environment with the construction methods of modern environmental management is what should be working on. Also, it is needed to focus on specific one group of people so that the results of the research will be more thorough, which will be helpful to connect indigenous wisdoms and western knowledges.

B1：原住民學童 CPS 空間概念課程與評量之教學平台發展與建置研究：總計畫

計畫主持人：趙貞怡 教授[1]

計畫簡介、成果、困境及未來期望

由國立臺北教育大學趙貞怡老師主持的「原住民學童 CPS 空間概念課程與評量之教學平台發展與建置研究：總計畫」，以原住民學童為對象，旨在發展與建置具原住民文化特色之 CPS（Collaborative Problem Solving）空間概念課程與評量之教學平台。本平台亦整合子計畫所開發之機械、能源科學、數學等教材與評量資源，藉此提供有志執行 CPS 課程或原住民教育者參考交流。

這三年多來的研究成果計有：

一、 已透過 39 次的定期會議、人機介面測試評估意見，建置 1 個 CPS 計畫網站及 1 個 CPS 教學平台。教學平台內共有「九步驟協作式問題解決教案設計系統」、「教學資源庫」、「生活化題組式評量系統」、「計畫分享」等功能頁面，未來仍將持續維護。

二、 已完成 54 個空間概念生活化題組式評量開發設計。

三、 已完成 14 個富有原民文化元素之空間概念互動式數位教材，並進行 8 次的教學示範活動，根據空間概念生活化題組式評量前後測結果顯示，參與學童的成績表現皆有顯著進步。未來將繼續開發互動式數位教材製作。

四、 已聯合子計畫於全台辦理 26 場的教師培訓，以及 15 場計畫推廣活動，並提供與會人士計畫文宣資料夾，以提升本團隊原民科教課程的能見度。

研究面臨的問題是偏鄉網路頻寬不夠，有時無法順暢使用網路平台即時評量記錄學習歷程，以及具有數學、科學背景且能以原住民母語進行教學的師資難覓。另有些原民部落地處偏遠不便參與培訓推廣活動，未來將加強平台宣傳服務，擴大 CPS 教學示範推廣範圍，並將現有教學平台延伸為行動教室模式，讓教師與學習者可透過行動載具進行線上課程、教案設計、無紙化即時評量、教材瀏覽等多元化課程活動與師資培訓。同時可利用此平台進行大數據資料蒐集與分析，以掌握原民學童的學習方式及有助提升學習成效的課程設計模式。

[1] 國立臺北教育大學課程與教學傳播科技研究所教授。

B1: The Development and Establishment of the Teaching Platform for Courses and Assessments on Indigenous Students' CPS Spatial Conception

Principal Investigator: Jenyi Chao[1]

Introduction, Achievements, Difficulties and Expectations

As the master project of "The Development and Establishment of the Teaching Platform for Courses and Assessments on Indigenous Students' CPS Spatial Conception", this project aims to develop and establish a teaching platform focused on the Collaborative Problem Solving （CPS） courses and assessments for aboriginal students. This platform also allows other sub-projects to develop courses and online assessments on basic machinery, energy science and mathematics. The resources are open to those who devote to CPS courses or aboriginal education.

The project achievements in these 3 years are listed below:

I. The CPS project website and teaching platform have been established. For the functions and pages in the platform, "9-Step CPS Teaching Plans System", "Teaching Resources Library", "Life-oriented Question-set Assessment System" and "Project Sharing" were constantly updated through 39 regular meetings.

II. Fifty-four Life-oriented Question-set Assessments were developed.

III. Fourteen interactive digital materials of spatial concepts with aboriginal culture elements were developed and 8 teaching demonstrations were held. The students' performances for question-set assessments in these two concepts after the teaching demonstration were markedly better than before the demonstration. More interactive digital materials will be developed in the future.

IV. The project and the sub-projects have organized 26 learning activities for teachers and 15 promotional activities across every region in Taiwan. The promotional documents were handed out to attendants in order to enhance the awareness of this aboriginal project.

The problem that the research faces is insufficient network bandwidth in remote areas. Sometimes, it's unable to use the online platform smoothly to record the learning process immediately. Also, it's difficult to find mathematics and science background teachers who can teach in indigenous native language.

It is inconvenient for teachers to participate in training and promotional activities because some indigenous tribes are located in remote areas. In the future, we will strengthen publicity services of platform, expand the promotion scope of the CPS demonstration teaching and extend existing teaching platform into mobile learning model, so that teachers and learners can carry out online courses, design of teaching plans, real-time evaluation, teaching materials browsing and other diversified curriculum activities and teacher training, etc.

At the same time, this platform can be used to collect and analyze large data to

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control the learning styles of aboriginal children and curriculum design model that helps enhance learning efficiency.

B2：原住民學童數位 CPS 基礎機械概念課程發展與建置之研究

計畫主持人：陳珍源 教授[1]

本計畫以原住民文化為基礎，開發協作式問題解決(Collaborative Problem Solving, CPS)與互動式教學的基礎機械課程教材。教材內容參照教育部課程大綱設計，屬於菜單類的「內建式課程教材」，因此教師可直接使用於平時課程中，學童透過與電腦互動，習得基礎機械的概念。本計畫以桃園市龜山區幸福國小與復興區介壽國小四至六年級學童為研究對象，而幸福國小為種子學校，以測驗卷及部落種子教師訪談來評量學童在基礎機械認知的改變情形，透過課程教學活動意見表、部落種子教師訪談及焦點團體座談意見，作為課程修正的參考。期望藉由課程的實施，可以有效地縮短原住民學童的科學學習落差，進而提昇學童科學興趣與能力。

本計畫開發之部份互動教學單元簡介如下：

簡單機械(齒輪) －「射日英雄」
遊戲情境
射日傳說的故事廣泛流傳於泰雅族部落，相傳太古時候，天上有兩個太陽，兩個都非常大，沒有晝夜之分，族長與耆老決定讓部落最精銳的三名勇士，前往太陽之地把一個太陽射下。自從那時候起，就有晝夜之分。
教材畫面
 
教材內容
操作方式：操作左上方齒輪控制下方齒輪巨弓移動，使用中間的紅色按鈕發射弓箭射擊畫面中移動的太陽 **科學概念：**瞭解兩齒輪咬合時，旋轉方向不同、兩齒輪咬合，齒輪的齒數多寡會影響另一齒輪轉動的圈數

簡單機械(輪軸) －「拉繩取水」
遊戲情境
小慶台跟著爸爸到山上打獵，帶來的水都喝光了，又累又渴，後來小慶台找到了一個有輪軸機關的水井，小慶台必須想辦法利用輪軸機關來幫小慶台取水給爸爸喝。
教材畫面

[1] 銘傳大學電子工程學系教授。

教材內容

操作方式：學童將手置於繩索後，畫面會出現對應學童拉繩索的手圖示，學童可以依照著此圖示的位置模擬拉繩索的動作，將手停留在「輪」的文字按鈕上，便會更改「軸」的文字按鈕，繩索於輪軸機關的施力位置亦會改變。

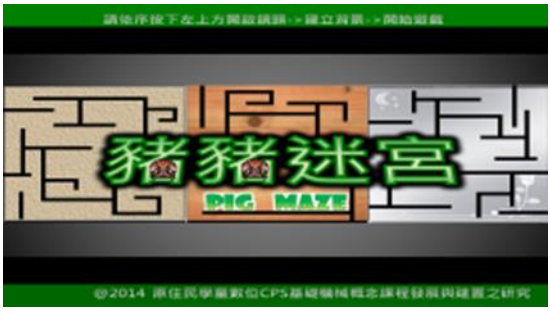
科學概念：讓學童瞭解「施力於輪省力費時」、「施力於軸省時費力」。

力與運動(摩擦力)－ 「豬豬迷宮」

遊戲情境

以泰雅族人常看到的動物-山豬為主角，情境為山豬迷路了必須找到回家的路

教材畫面



教材內容

操作方式：傾斜砂紙會使小豬有不同的滑動速度，控制小豬回到位在中間的家。

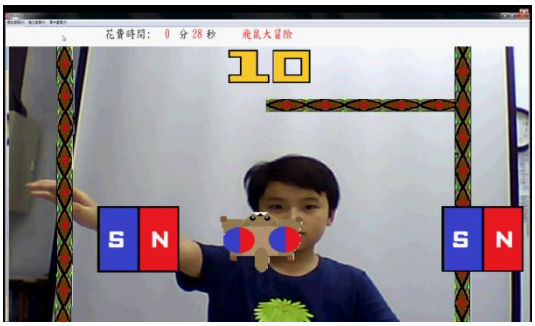
科學概念：不同材質的摩擦力會不同。

磁力-「小飛鼠大冒險」

遊戲情境

身為好奇寶寶的飛鼠大慶跑到森林遊玩，發現了兩個磁鐵，想帶回去分享給牠的朋友，但是外面遊玩太久了，居然忘了回家的路，也就是迷路了，大慶在障礙重重的森林裡暈頭轉向的，該如何回家?

教材畫面



教材內容

操作方式：操作左右兩邊的磁鐵，控制飛鼠的行徑，使飛鼠閃躲障礙物到達終點。

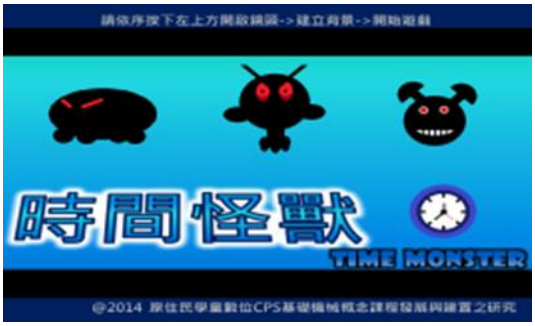
科學概念：磁鐵同性相斥，異性相吸的概念。

時間的量測 - 「時間怪獸」

遊戲情境

部落被時間怪獸入侵了，他們打亂的大家的作息時間，讓獵人睡過頭忘了打獵時間、漁夫忘了捕魚時間、小朋友忘了上學時間，請幫忙把被調亂的時間改回來吧!

教材畫面



教材內容

操作方式：根據問題的提示選擇正確的答案，透過人機互動，使分針順時針轉動或逆時針轉動。

科學概念：認識時間的表示與時間的進位。

B2: Digital CPS Course of Basic Mechanics for Children of Indigenous Peoples

Principal Investigator: Jen-Yang Chen[1]

This project based on indigenous peoples to develop the Collaborative Problem Solving (CPS) with interactive course of mechanics. The course material was designed on the basis of the syllabus announced by Ministry of Education and belonged to menu-type of built-in course material. School teachers could utilize the material in regular lessons; students could interact with the material on the computer to learn the concept of basic mechanics. The subjects of this project were the fourth to sixth grade students from Hsing-Fu Elementary School of Guishan District, and Jeso Elementary School of Fuhsing District, Taoyuan City. Hsing-Fu Elementary School was the seed school. Test sheets and interviews with seed teachers from the tribe were evaluated in order to understand the cognitive progress students made regarding basic mechanics. The course was modified according to the feedback questionnaire, interviews with seed teachers from the tribe, and opinions gathering from focal forums. The project was conducted with a wish to increase children's interest and ability toward science.

Some interactive course units developed by the project are as follows.

Simple mechanics (cogwheel): Shooting Hero

scenario

The legend about the hero that shot down the sun is a popular story among Atayal tribes. It is said that in the remote past, there were two suns in the sky. Both of them were huge. There was no difference between night and day. The chief of the tribe and the elders decided to send three bravest warriors to the place where the suns lived and shoot down one of the suns. From then on, there have been night and day.

Images of the materials

Course materials

Operation: operating the cogwheel in the upper left corner to move the cogwheel of the giant bow below it. Push the red button to shoot an arrow to the sun moving in the image.

Scientific concept: understanding that when two cogwheels mesh, the rotating direction and the number of teeth of the cogwheels influence the number of circles the

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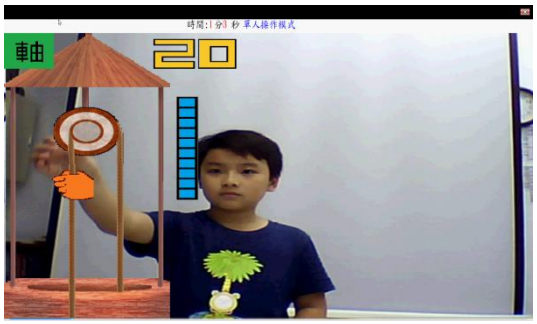
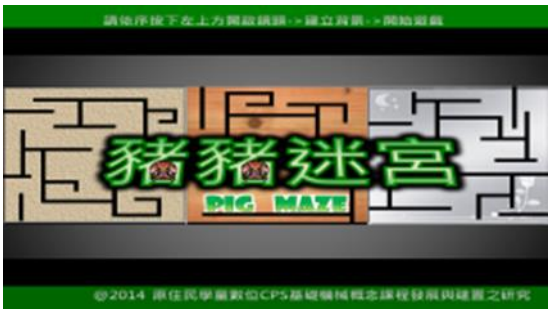
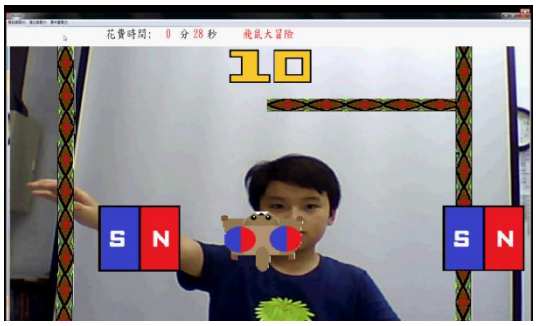
other cogwheel rotate.

Simple mechanics (axle): Pull the rope to obtain water
scenario
Little Ching-Tai and his father go for hunting in the hills. They have drunk all the water they brought. They are tired and thirsty. Little Ching-Tai found a well with an axle. He has to find out how to use the axle to obtain water for his father.
Images of the materials
 
Course materials
Operation: students place their hands on the rope in the image. The sign corresponding to the hand shows up in the image. Students can imitate the movement of pulling the rope down according to the location of the sign. When they stop their hands on the button illustrating “wheel”, the button illustrating “shaft” changes. The place where students put their strength on the rope also changes. Scientific Concept: Allowing students to understand putting strength on “wheel” saves strength and but takes time while putting strength on shaft saves time but takes strength.

Force and motion– Piggy labyrinth
scenario
In this scenario, mountain pig, the famous animal in Atayal tribes is chosen to be the main character. This mountain pig is lost and must finds its way home.
Images of the materials
 
Course materials

Operation: Tilting the sand paper creates different sliding speed of Piggy and allows players to guide Piggy home, which locates in the labyrinth center.

Scientific concept: Different texture creates different friction.

Magnetic force: The big adventure of the little flying mouse	
scenario	
Being a curious creature, the flying mouse Big Ching finds two magnets when he explores the forest. He wants to bring back the two magnets and shows them to his friends. But, he is out in the forest for too long and forgets his way home. He is actually lost. Big Ching is lost in confusion caused by all kinds of obstacles in the forest. How is he going to get out?	
Images of the materials	
	
Course materials	
Operation: operate both magnets on the sides to control the tracks of the flying mouse and guide it to the destination while avoiding all the obstacles. Scientific concept: Like poles of magnets repel. Unlike poles attract.	

B3：原住民學童 CPS 空間概念課程與評量之教學平台發展與建置研究—子計畫二：原住民學童數位 CPS 自然與生活科技課程發展與建置之研究：以能源為例

計畫主持人：劉傳璽 教授[1]

計畫簡介、成果、困境及未來期望

由國立臺灣師範大學劉傳璽老師主持的「原住民學童數位 CPS 自然與生活科技課程發展與建置之研究—以能源為例」，針對原住民國小學童，以能源科學為主題，透過 CPS 教學策略開發數位教材與評量資源，藉此提供有志執行 CPS 課程或原住民教育者參考交流。

這三年多來的研究成果計有：

一、已完成 12 個能源科學生活化題組式評量開發設計。

二、已完成 16 個回應泰雅文化之能源科學互動式數位教材。

三、進行 6 次的教學示範活動，根據能源科學生活化題組式評量前後測結果顯示，參與學童的成績表現皆有顯著進步。

四、在 17 所漢族偏鄉學校推廣所發展的 CPS 能源科學課程，包含 34 場教學示範活動與 17 場教師研習。

五、在 2 所原住民學校進行 CPS 能源科學課程推廣，包含 4 場教學示範與 2 場教師研習。

研究面臨的問題是即便學生在示範課程課堂中表現強烈學習動機，但因為時間與進度的限制，學校教師常常沒有其他心力可以自行發展相關的課程資料，在了解教師所面臨的各種問題後，計畫會提供更豐富的教學資源，減輕上課教師的壓力，增進其參與 CPS 能源課程教學的意願。

[1] 國立臺灣師範大學機電工程學系教授。

B3: The Development and Establishment of the Teaching Platform for Courses and Assessments on Indigenous Students' CPS Spatial Conception -- To develop an interactive energy curriculum suitable for the indigenous students of elementary schools

Principal Investigator: Chuan-Hsi Liu[1]

Introduction, Achievements, Difficulties and Expectations

Coordinated by Professor Chuan-Hsi Liu of National Taiwan Normal University, this project is to develop an interactive energy curriculum suitable for the indigenous students of elementary schools. The energy curriculum, composed of a series of interactive learning activities, still adopts the collaborative problem solving (CPS) teaching strategy, and the design of the curriculum will be based on the culture background of the indigenous children in order to promote their science learning interest and problem-solving skills.

The outcome of the project is summarized as follows:

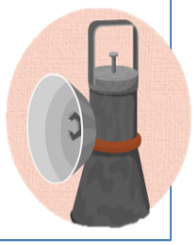
1. 12 sets of PISA-like assessment tests
2. 16 sets of interactive e-learning materials
3. 6 demonstration activities for the science teachers
4. The CPS energy curriculum has been introduced to 17 elementary schools for promotion
5. The CPS energy curriculum has also been introduced to another 2 indigenous elementary schools

The main challenge for the project is the curriculum design for the school teachers. Although science teachers understand that the learning motivation of the students has been significantly promoted through the CPS teaching strategy, they don't have too much time to develop the CPS curriculum. After understanding the challenge, we have been providing more teaching resources, including learning materials and activities, and get more school teachers involved in the project in order to spread and promote this project.

[1] Professor, Department of Mechatronic Engineering, National Taiwan Normal University

電土是一種礦土，又稱電石，主要是含有一種名為碳化鈣化學成分的物質。電土取自於大自然，也可於煉鐵過程中取得。固體的電土加水之後，碳化鈣會和水起化學反應而生成俗稱電石氣的乙炔氣體，可以燃燒，電土燈正是燃燒乙炔而發出火焰，做為照明的工具，夜晚上山打飛鼠，當電土燈的光照到飛鼠，飛鼠的眼睛會閃閃發亮，獵人就可以很快鎖定目標。

根據上文，請問：



1. _____ 化學能是屬於
(1)可再生能源 (2)不可再生能源 (3)次級能源

2. _____ 此種能源具有何種特性？
(1)面臨能源危機 (2)環保 (3)造成汙染

C1：提昇排灣族學童數理競爭力與科普活動之研究

計畫主持人：高慧蓮 主任[1]

摘要

本研究計畫其宗旨乃在提昇原住民數理競爭力與科普活動之研究，建立原住民學童與青少年科學閱讀能力成長監控機制、發展科學閱讀教材（ScienceReading）、數理教學模組(Pej-msim)、科普活動(Pej-psa)。並且應用本研究所發展出來的SR、Pej-msim、Pej-psa 於實際教學情境中，以探索本研究所開發的品質及有用性，同時修正完成精細規劃以排灣族文化為基礎之數位學習平台（e-learning），進行推廣研究。

在這些年來以「協同行動研究法」(Collaborative Action Research)的研究理念及做法，邀請排灣族耆老、平地與原住民學校教師參與研究，以國中小學生為研究對象，藉由收集相關排灣族科學智慧，建立閱讀能力成長監控機制，並進行數位學習系統開發的起始階段。將所發展的應用於實際教學情境中，透過多元的資料蒐集方式，以探究研究教師實施所遭遇的問題與因應策略、實踐的歷程與轉變、及實施後的影響，精細規劃與建構數位學習系統。根據這些資料，研究群再修正所開發的，以應用到其他原住民學校進行以數位學習系統的移轉階段的教師專業成長，並且以為ePej-msc 基礎，推廣SR、Pej-msim、Pej-psa、e-learning。

本研究計畫這幾年的研究亮點，是讓原住民學校教師暨原住民籍國小教師科學教育專業再升級!例如原住民音樂教師、文化教師接受科學教育的碩士班課程後，都已經能夠隨時掌握文化中的科學。而且原住民學校教師也願意幫忙尋求傳統文化中的科學智慧，還有原住民碩士研究生，在教學中能融入科學探究，以提昇原住民學童的科學素養。

研究團隊者們心中認為的困境，感覺計畫一直與時間在賽跑。因為國中小原有的課業進度壓力，能夠參與研究的學校與教師，原本意願就不高，且部落中耆老的凋零、文化的斷層種種因素，讓研究一直處於艱難的狀態下。因此對於未來研究的發想，總希望能夠有長遠的計畫，且是一持續的規劃，而不是換了位置就換想法的研究，畢竟原住民學童的數理教育學習困境，是需要長時間的關懷與照顧。

關鍵詞：原住民教育、科學閱讀、科普活動、數位學習平台、協同行動研究法

關鍵詞：文化回應科學教學、科學閱讀、奈米科技新知、數位學習

[1] 國立屏東大學科普傳播學系(含數理教育碩士班)教授兼系主任。

C1: A Study for Enhance Students Mathematical Paiwan Competitiveness and Science Activities

Principal Investigator: Chih-Lung Lin[1]

Abstract

Research highlights of the study in recent years are to allow aboriginal school teachers and aboriginal teachers in elementary schools upgrade their professional growth on science education! For example, indigenous music teachers and cultural teachers have been able to master science in culures after receiving the science education master's program.

Research team members continued to invite Paiwan and Rukai family elderly, as well as Han and indigenous school teachers to participate in the research based on “collaborative action research method”. The investigators contined to analyse students’ starting behavior and textbook, as well as arrange and transforme scientific wisdom of Paiwan and Rukai, and review literatures etc., to design Paiwan and Rukai culture-based teaching modules in order to strengthen scientific literacy for indigenous students.

The purpose of this study is to develop a culture responsive science reading program for fifth- and sixth-grade students of Paiwan Tribe.We developed a set of tests of reading component ability for monitoring the students’ progress, a series of science texts based on Paiwan culture, and a culture responsive science reading instruction.

The main purpose of this study is to enhancing indigence awareness in nanotechnology with the popular science activities. In this study, we will transmit nanotechnology knowledge from academic institutions to Indigence primary and junior high schools, so the indigence primary and junior high school teachers and students have the opportunity to accept the knowledge of nanotechnology, hands on experiments.This study investigated the indigenous schools recognize nanotechnology new knowledge.

The research team recruited indigenous people to participate in teacher training for indigenous science education. Therefore, the research team thought how to conduct indigenous science education when in cooperation with the tribes? Then, the investigators developed teaching modules based on Paiwan culture and Cultural Responsive Science Teaching Model (CRSTM). In addition, the investigators made e-books of the above modules and put them on the digital learning platform.

Keywords: culturally responsive science teaching, science reading, nanotechnology, e-learing.

[1] Professor & Chair of Department, Department of Science Communication, National Pingtung University, Taiwan. E-mail: hkao@mail.nptu.edu.tw；hueylienkao@yahoo.com.tw

C3：提昇排灣族學童數理競爭力與科普活動之研究—子計畫二：發展與應用數位學習系統縮短原住民數學學習落差之研究

計畫主持人：林志隆 助理教授[1]

計畫簡介

本計畫旨在縮短原住民學童的數學學習落差，而本子計畫之主要任務有兩個。一是協助總計畫建置原住民師生專用的數位學習平台。二是設計以原住民文化融入的數學電子教科書。期盼藉由電子書的文化與多媒體元素並結合數位學習平台的功能來提升原住民學童學習數學的動機與興趣，進而達到縮短原住民學童數學學習落差之目的。

本計畫主要在探討原住民國小學童運用數位學習平台與電子書進行數學學習之成效。本研究第三年為移轉階段，將數位學習平台上線使用，持續修正系統與精緻化教學模組，並進行教育訓練、實驗教學及師資培育。

本計畫亦架設了提升排灣族學童數理競爭力與科普活動之研究網站供總計畫與其他子計畫使用。為了順應人手一台行動載具的資訊時代潮流，本子計畫所發展的網站與數位學習平台將以支援多元與跨平台的資訊產品為設計理念，讓使用者能在電腦、平板或手機，Android 或 Mac 之不同系統上瀏覽與學習。網址為 http://paiwan.nptu.edu.tw/Paiwan/index.aspx。

成果

一、數位學習平台建置

本研究建置的「數位學習平台」是一套以網路教學管理系統(Learning Management System，簡稱 LMS)為架構的網路操作介面，其中包含三種功能，分別是「管理者」(Manager)、「教學者」(Instructor)、「學習者」(Learner)，三者角色功能分述如下：

1. 管理者(Manager)：負責管理平台，協助教學者製作數位教材並上傳平台，如圖 1。
2. 教學者(Instructor)：製作課程內容、設計教學活動、評量，促進學生小組合作學習，如圖 2。
3. 學習者(Learner)：電子書學習、學習歷程紀錄等，如圖 3。

圖 1 管理者介面圖

圖 2 教學者介面

圖 3 學習者介面

二、教育訓練

本計畫舉辦了 4 場電子書教育訓練（如圖 4、5、6、7），對象為屏東區的國小老師，包括萬丹國小、屏東附小、口社國小、地磨兒國小等。其中萬丹國小和屏東附小

[1] 國立屏東大學資訊科學系助理教授。

老師皆有協助本計畫產出 5 本電子書、口社國小和地磨兒各產出 1 本電子書，目前尚在精緻化中。


圖 4


圖 5


圖 6


圖 7

三、精緻化電子書

本研究目前透過數位學習平台進行實驗施測的精緻化電子書共 30 本。已經精緻化完成的電子書有 5 本。內容包含目錄、影片、文化背景、課程內容、小測驗、即時評量（如圖 8、9、10、11）。


圖 8 課程內容

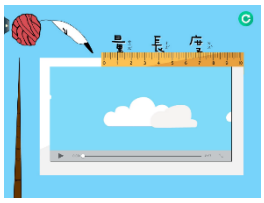


圖 9 教學影片

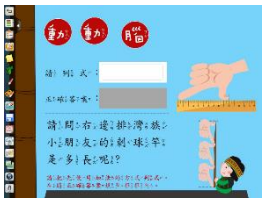


圖 10 小測驗


圖 11 即時評量

研究困境

1. 參與研究計畫學校意願不高，時常為了找尋合作學校困擾。
2. 常受限於設備與網路的老舊與速度。
3. 研究計畫執行完畢後，持續深耕校園難度較高。

未來研究發想

1. 編製更多互動式電子書數位教材。
2. 加強師資培訓。
3. 結合行動學習計畫，打造偏鄉 M-Learning。
4. 強化數位學習平台教學與學習的功能。
5. 提升課堂學習的積極性（學生）及掌握性（老師），增加即時互動功能。

C3: A Study for Enhance Students Mathematical Paiwan Competitiveness and Science Activities: To Shorten the Mathematical Learning Gap in Aboriginal Students

Principal Investigator: Chih-Lung Lin[1]

Introduction

The program aims to shorten the mathematical learning gap in aboriginal students, and the primary tasks of the sub-program are two-fold. The first task is to assist the master program to build a digital learning platform for aboriginal teachers and students. The second task is to design electronic mathematical textbooks with characteristics of aboriginal culture. It is expected that aboriginal students' motivation and interest in learning mathematics can be enhanced through the culture of e-books, multimedia elements and digital learning platform, thereby attaining the objective of shortening the mathematical learning gap in aboriginal students.

This program is designed to explore the effectiveness of using digital learning platform and e-books to learn mathematics by the aboriginal primary school students. This study used digital learning platform will be put into on-line use. This study will continuously correct system and refine teaching modules, and conduct education and training experimental teaching and teacher training.

This study also sets up a research website regarding improving the mathematical competitiveness and activities to popularize science of Paiwan students for the use of the master program and other sub-programs. In order to adapt to the information age when everyone carries one mobile device, the website and digital learning platform developed by this sub-program will take supporting diverse and multi-platform information products as the design concept, hence allowing users to browse and learn on computers, tablets or mobile phones, or different systems of Android or Mac. The website is http://paiwan.nptu.edu.tw/Paiwan/index.aspx.

Results

I. Digital learning platform built

This study builds "digital learning platform" is a network management system (Learning Management System, LMS for short) for the architecture of the network interface, which contains three functions, namely the " Manager ",the" Instructor ", and the "Learner", the roles of the three functions are as follows:

1. Manager：Responsible for managing the platform, assisting teachers in producing digital textbooks and upload platform, as Figure 1.

2. Instructor：Making curriculum content, teaching activities, evaluation, promoting students ' cooperative learning groups, as Figure 2.

3. Learner：EBook learn, learning records, as Figure 3.

[1] Assistant Professor, Department & Graduate School of Computer Science, National Pingtung University, Taiwan. E-mail: clin@mail.nptu.edu.tw

Figure 1. Manager interface

Figure 2. Instructor interface

Figure 3. Learner interface

II. Education and training

4 e-books education training are planned (figures 4, 5, 6, 7), objects for the Pingtung district elementary teachers, including small Banten, Pingtung County primary school, elementary school, mill elementary school, etc. Banten small and Pingtung County school teacher there to help the planned 5 eBook, small mouth and rubbing the output 1 eBook, it is refined.


Figure 4.


Figure 5.


Figure 6.


Figure 7.

III. Exquisite e-books

This study is through digital learning platform for the experimental measurement of refined e-books a total of 30. Has been refined to complete eBook 5. Includes directory, film, cultural background, courses, quizzes, real time evaluation (see Figure 8, 9, 10, 11).

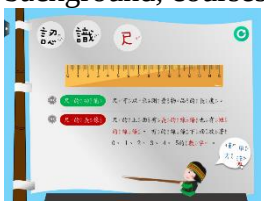


Figure 8. Content

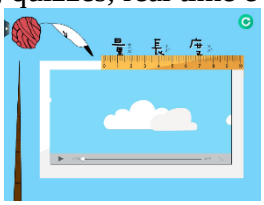


Figure 9. Video


Figure 10. Quiz


Figure 11. Evaluation

Difficulties

1. Schools participating in the research project are reluctant, often to find the school plagued.
2. Often old with limited equipment and network speed.
3. After the completion of research projects, continuing deep school difficult.

Future research

1. Develop more interactive e-book digital textbooks
2. Strengthening teachers ' training
3. Study plan of action, to create M-Learning.
4. Strengthening the function of digital learning platform for teaching and learning.
5. Enhance classroom learning initiative (students) and master (teacher), real-time interactive features.

C4：以科普活動提昇原住民認識奈米科技新知之研究

計畫主持人：施焜耀 副教授[1]

計畫參與人員（兼任助理）：巫毓翊、黃琤伶、韓鎮遠、戴呈宇、朱恩瑭、王一修、楊于蓮、孫郁欣、李舜文

一、計畫簡介

本研究計畫目標主要是以科普活動提昇原住民認識奈米科技新知。計畫中將奈米科技知識自學術機構、學校、專業領域向下紮根普及於原住民中小學教育，讓原住民中小學師生有機會接受奈米科技知識，動手做實驗並參與相關研究，也藉由閱讀教材之開發、教師增能進修之機制與課程規劃深根原住民教師有關奈米科技新知內涵。而數位學習平台的建置與推廣也將提昇原住民認識奈米科技新知。

為了探討原住民學校認識奈米科技新知，研究以生動活潑、深入淺出的內容介紹奈米科技新知與應用。過程中使用奈米科技教材編輯電子書軟體，藉由「奈米科技新知校園巡迴展」方式進行，推廣奈米科技新知。透過原住民學校參與「奈米科技新知校園巡迴展」，體驗奈米科技學習 e 化的教學活動，以提昇屏東地區原住民學童對奈米科技的學習興趣，並且希望藉由活動之推廣，落實屏東地區原住民學童對於奈米科技的認知。

二、計畫成果

研究者利用原住民部落地區實地考察、奈米科技學習成效比較檢測題、奈米科技新知非正式晤談原住民學生等資料收集。藉由研究團隊與屏東縣原住民國中小學的安排協調，透過電子書教材，使原住民青少年與學童從「認識奈米科技」到「應用奈米科技」之實施，具體提昇屏東地區原住民青少年與學童對奈米科技的學習興趣，希望藉由科學活動之推廣，落實屏東地區原住民青少年與學童對於奈米科技之認識與認知。

計畫以「認識奈米科技新知」科普活動巡迴展，提供原住民學童奈米新知、並將第一年研發之排灣族「認識奈米科技新知」閱讀教材建構數位學習系統，另一方面，並進行奈米科技數位學習體驗營活動，以界定學習者對於數位學習系統的需求與適應性。第二年共開發科普活動教材五份，電子書五份。總計 348 名學童參與近十場的奈米科技體驗營活動與數位學習活動。第三年共開發科普活動教材五份，電子書五份。總計約 450 名學童參與近十場的奈米科技體驗營活動與數位學習活動。

三、研究困境

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當學校行政與教師專業衝突時，研究計畫團隊該如何協調彼此之間的困境呢?這是一個教育的問題，對於學科學背景的研究團隊是很大的挑戰，而我們也努力改善中。

四、未來研究發想

如果研究能不中斷的，不管是中期或長期計畫，這樣對原住民學童是一個保障，也是對研究團隊辛辛苦苦建立的關係更能傳承。在下一階段若能將此成果推廣到其他部落區域，將可深化學習效果，而不至於合作學校常常問，你們何時再來呢?

關鍵詞：原住民中小學、認識奈米科技新知、科普活動巡迴展、數位學習

C4: A Study for Enhancing Aboriginal Awareness in Nanotechnology with the Popular Science Activities

Principal Investigator: Kun-Yauh Shih[1]

1. Introduction

The main purpose of this four-year study is to enhancing aboriginal awareness in nanotechnology with the popular science activities. In this study, we will transmit nanotechnology knowledge from academic institutions to Aboriginal primary and junior high schools, so the aboriginal primary and junior high school teachers and students have the opportunity to accept the knowledge of nanotechnology, hands on experiments. With the development of reading materials, training class for K-12 teachers will improve the awareness of nanotechnology for indigenous teachers. We will also setup the website about this project. This database will form a platform between K-12 school and cooperative learning on nanotechnology education.

A lively, easy to understand concepts of the applications were introduced the new knowledge of nanotechnology. Nanotechnology teaching materials used during editing software e-book by "nanotechnology new knowledge campus tour exhibition" ways to promote nanotechnology knowledge. Participation by indigenous schools "nanotechnology new knowledge campus tour exhibition" e-learning experience nanotechnology teaching activities to enhance the Pingtung area of nanotechnology indigenous students' interest in learning, and hope that through promotional activities, Pingtung area to implement indigenous students for nanotechnology awareness.

2.Result

The researchers used field trips indigenous tribal areas, nanotechnology study results comparing the detected problems, nanotechnology new knowledge informal interviews and other data collection native students. By the research team and Pingtung County junior and elementary school Paiwan indigenous coordination arrangements, through the e-book materials, make indigenous teenager and children from the "understanding nanotechnology" to implement the "application of nanotechnology" specifically to enhance the original Pingtung area resident students interested in learning nanotechnology, hoping that through the promotion of scientific activities, the implementation of Pingtung indigenous students for understanding and awareness of nanotechnology.

The implementation of the second year, we hold the "nanotechnology camp" and "nanotechnology" traveling exhibition to provide aboriginal students nanotechnology information. We also constructed the E-learning system from the reading materials in nanotechnology which we have produced in the first year. There were five reading materials and five E-Books developed. A total of 348 children participated in near ten activities of nanotechnology Camp and E-learning. In the third year, there were five reading materials and five E-Books developed. A total of 450 children participated in near ten activities of nanotechnology Camp and E-learning.

3.Challenges

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When the school administration conflicts with the teachers' professional, how the research team coordinates each other's dilemma? This is an education issue, and also a big challenge for scientific researchers. We also strive to improve the problem.

4.Opportunities

This is a guarantee for aboriginal schoolchildren if the project is uninterrupted, whether in the medium or long term research. The research team worked so hard to build relationships that could be continued. In the next stage if the results can be extended to other tribal areas, will be able to deepen the learning.

Keywords：Aboriginal schools, nanotechnology, popular science activities, E-learning

D1：雲端數學部落教室：原住民小學數學教材發展與師資培育

計畫主持人：姚如芬 所長[1]

計畫簡介

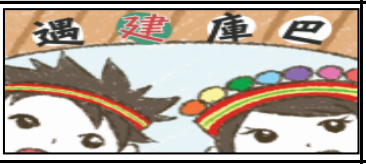
台灣的原住民族其實有其特殊且異於漢族的文化，然我國不論是教材的編寫或是課程的設計卻均是以主流文化為考量主體，極少慮及原住民各族群與漢族的文化差異。然而目前台灣坊間有關原住民數學教材或相關讀物並不多見，因此，「雲端數學部落教室」總計畫的首要任務即是發展原住民小學數學教材，期望能為部落學童營造更為合宜的數學學習環境，並從更多元的管道來探究與理解部落學童的數學學習情形。

由於「雲端數學部落教室」總計畫的研究重點主要是聚焦在「原民數學教材的發展與實踐」，因此，研究的進行遂以此為脈絡，共經歷了「準備與規劃」、「探索與理解」、「閱讀與設計」、「評論與修訂」、以及「實踐與反省」等五個重要階段。研究的現場主要在嘉義縣阿里山鄉的部落小學，大多數是鄒族的孩子。

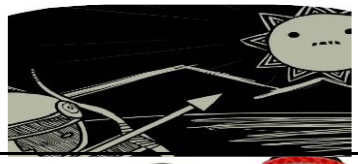
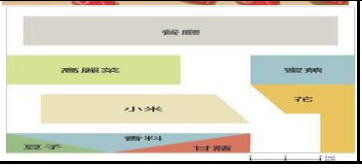
三年來，「雲端數學部落教室」總計畫「新創」的原民數學教材共計有十套，如表一所示；另亦有「轉化」版原民數學教材五套。

藉由各套教材的實踐，透過觀察、晤談以及相關文件的蒐集與分析，總計畫嘗試理解與整理部落學童數學概念的學習情形，同時亦探尋部落學童對於透過原民數學教材學習數學的相關回應。研究發現：原民數學教材的實踐對於部落學童數學概念的建構與學習是有助益的，且部落學童對於透過原民數學教材學習數學亦多是呈現正向的反應。

表一、「雲端數學部落教室」總計畫三年來新創的原民數學教材一覽表

族別	名稱（年級）	課本	分年細目/數學內容	節數
鄒族	遇建庫巴(3)		3-n-12、3-n-16、3-s-01、3-s-02/ 一位小數計算、重量、周長、體積前置概念	4
泰雅族	小雅小泰冒險旅程(3)		3-n-01、3-n-06、3-n-08、3-n-12、3-n-17、3-n-18、3-s-01、3-s-02、3-s-04/ 乘法、周長、面積	7
布農族	奇幻怪潭迷走記(5)		5-n-06、5-n-07、5-a-01、5-a-03/ 異分母比較與加減、分配律、四則運算	4

[1] 國立嘉義大學數理教育研究所教授兼所長。

鄒族	復仇的山豬(5)		5-a-01、5-a-02、5-a-03/ 四則運算	5
鄒族	塔山愛情故事(1)		1-n-01、1-n-09、1-n-10/ 數一數、分類、比長短	5
鄒族	鄒記(5)		5-n-03、5-n-14、5-n-15/ 時間的計算、四則運算、比率	4
鄒族	長毛公公(3)		3-s-01、3-s-02、3-s-05、3-s-06/ 周長與面積	10
布農族	射日夏令營(3)		3-n-13/ 認識「日」、「時」、「分」、「秒」，並做時間的加減計算	4
泰雅族	神奇呼喚術(2)		2-n-06、2-n-07/ 乘法、分裝與平分	7
鄒族	鄒 More 風味館(6)		6-s-02、6-n-07、6-d-01/ 平面圖形放大、縮小、比例尺、比和比值、圓形圖	6

D1: Cloud Math Classroom in the Tribe－Development of Culture-Based Mathematics Instructional Modules and Teacher Education for Indigenous Children

Principal Investigator: Ru-Fen Yao[1]

Abstract

Based on “indigenous children’ difficulties in learning mathematics” and "the lack of indigenous culture-based mathematical learning materials" in Taiwan, the most important focus of this four-year project is to create opportunities and improve the environments of mathematics learning for indigenous children through the development of culture-based mathematics instructional modules. Through five stages of guidance, including "preparation and planning", "exploration and understanding", "reading and design", "comment and revision", and "practice and reflection", the researcher led in-service teachers and pre-service teachers to enter several indigenous tribes in A-Li mountain of Chia-Yi County, and designed culture-based math instructional modules for indigenous students of elementary schools. The participants worked together to develop fifteen sets of culture-based math instructional modules in total. Based on observation, interview, and analysis of related documents, it was shown that the implementation through culture-based mathematics instructional modules could motivate students' interest in learning math, and enhance their initiatives in the classroom. Hopefully, such cooperation between universities and local elementary schools will lead to improvement in the mathematics learning environments for the tribes.

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D3：雲端數學部落教室—原住民小學數學教材發展與師資培育-子計畫二：以眼動技術探究原住民學童數學學習成效

計畫主持人：賴孟龍 助理教授

Principal Investigator: Meng-Lung Lai[1]

Previous studies consistently demonstrated that indigenous students' had great difficulties learning mathematics and that a majority of indigenous students were not interested in learning mathematics. However, these findings could have been explained by the fact that indigenous students were simply not familiar with the materials and contexts to be learned in the regular commercial textbooks, which rendered the indigenous students not interested in learning mathematics and consequently the poor performance was thus expected.

In order to examine whether indigenous students learn better in the contexts and materials they are familiar with, the culture-based mathematics module (CBMM) was created. We investigated indigenous students' performance in CBMM using the eye tracking technology. Specifically, we looked into fourth and fifth grade indigenous students' accuracy and reaction time on solving questions (e.g., length conversions) presented in CBMM. Results showed that the indigenous students greatly benefitted from CBMM and learned better with the instruction of CBMM. On top of that, the indigenous students solved the problem more efficiently and effectively after the instruction of CBMM. Eye movements indicated that indigenous students paid more attention to relevant information than the redundant and extraneous information.

In addition, we also examined whether indigenous students were more interested and motivated in reading CBMM than the regular commercial mathematics textbooks, we looked into indigenous students' reading behaviors on both materials using the eye tracking technology. By means of the eye tracking device, we could unveil indigenous students' affective state and cognitive load from their pupillary responses. Results showed that indigenous students were more interested and more motivated to read CBMM than the commercial textbooks, paying more attention to the former than the latter, and with larger pupillary responses to the former than the latter. In addition, the pupillary responses showed that it took less cognitive load for the indigenous students to read CBMM.

Future studies will be conducted in terms of two perspectives, making better use of the eye tracking device and integrating other cognitive instruments into the eye-tracking environment.

First, as of now, nearly all the eye tracking studies used only ONE eye tracker in the lab environment, which somewhat restricts the practical use of the equipment in studying interactions between different students, and also minimizes the generalization of the results for authentic learning. For future studies, we will employ two or more eye trackers to investigate social cognition issues (e.g., teacher–student interactions during mathematics problem solving) or students' moment-to-moment eye fixations in realistic

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classroom settings (e.g., what and where indigenous students are looking during teachers' presentations).

Second, given the fact that computational equipment employed to measure human cognition is becoming easier to access (e.g., more affordable), it is being gradually applied in educational and psychology research. We will try to coordinate eye trackers with other non-invasive methods, such as Electroenecephalograh (EEG) and brain imaging (ERP), to measure and collect the various physiological responses of indigenous students. By doing so, we could gain more knowledge of indigenous students' thought processes during learning.

D4：雲端數學部落教室：原住民小學數學教材發展與師資培育—子計畫三：原住民小學數位學習系統之建置

計畫主持人：林志鴻 副教授

Principal Investigator: Chih-Hung Lin[1]

1. 計畫簡介

計畫簡介：子計畫三『原住民小學數位學習系統之建置』主要目的在於協助與串聯總計畫與子計畫所開發之原民教材與科普活動內容數位化，提供偏遠部落學童與部落教師完整之雲端數位學習語進修之空間與機會，擴展其對於數學學習之深度與廣度。同時與子計畫二配合，開發眼動技術所需之數位教材平台，並將所有數位平台的學習歷程檔案交送子計畫二進行分析，以掌握部落學童與部落教師之學習情況，進而提出改進策略。子計畫三的工作包含三大系統建置；（1）部落學童學習系統建置：完成所有與原民學童學習相關之數位學習平台建置、雲端環境設定、教材資料數位電子書製作等；（2）教師進修培訓系統建置：教師透過進修培訓系統之培訓，可以提升教師在數學教學上之能力與素質；（3）動態數學教材建置：根據課綱分年細目，設計相對應之 GeoGebra 動態數學教材。

2. 成果

數位學習平台、數位電子書、科普電子書、動態數學 GeoGebra 工具、研究期刊論文與會議論文

3. 研究困境

由於開發一本數位文化數學電子書，以及開發動態數學 GeoGebra 工具，均需花費相當多時間，包含事前討論、觀課、製作、試用、再討論、再修正等等程序，因此研究時程內所能開發的數量有限。

4. 未來研究

(1)原住民虛擬實境(VR)教材建置：

透過 360 VR 攝影機以建置文化融入式教材，並搭配 Google Cardboard 平價裝置(100 元以內)即可讓原住民學童體驗虛擬實境學習，而學習過程可搭配腦波儀檢測學習專注度與放鬆度，所得結果可提供未來開發原住民 VR 教材參考。

(2)穿戴式腦波儀技術導入觀察以下面向之影響：

i.教材：

比較本計畫過去三年所建置開發之文化數學教材(包括數位電子書、動態數學工具、線上測驗等)與平地教材在學習專注度/放鬆度之差異，以提供教材開發與改進意見，進而將相關資訊提供給教師，了解不同學習風格學生適用何種設計風格教材，達到個別化教材需求。

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欲探究之教材種類包括紙本教材、數位二維教材(如電子書、網站)及數位三維教材(如 VR 虛擬實境教材)。

ii.教法：搭配文化數學教材並透過不同的教學法(如 JiTT)，透過腦波儀所得之數據分析，了解不同教學法對學生持續專注力(sustained attention)的影響，已找出符合原住民學童個別的有效教學方式。

E1：原住民文化融入式健康醫療與環境科學課程與師資培訓

計畫主持人：華國媛（阿莫伊・蘿夏薈) 副教授[1]

計畫簡介

本研究計畫第二期為行政院科部委託國立臺北科技大學分子科學與工程系暨有機高分子研究所華國媛教授執行，計畫名稱：原住民文化融入式健康醫療與環境科學課程與師資培訓（計畫編號：NSC 102-2511-S-027-002-MY4）。在第二期計畫當中，為求完臻研究計畫目標之達成與執行期程之順暢，本計畫乃結合醫療、環境、數位、文化等五位相關領域專家與學者組成計畫研究團隊。在實際實驗與推廣中，與六地方政府單位與公益機構合作並與 15 所原住民中小學中 61 位行政人員與教師合作執行本計畫第二期執行項目。計畫期間(2013.8-至今)，我們利用資訊科技的技術來開發適合原住民國小五年級「文化融入式國小健康與體育課程」，與適宜南排灣族七年級「文化融入式國中自然與生活科技課程」等二項數位網路學習平台，並配合實驗課程教學。為達研究之目的，本期總體計畫目標主要為右列三點:1)建置國小原住民網路數位教學模式、2）建置國中原住民網路數位教學模式、3）推廣與開課原住民地區中小學文化融入式課程之師資訓培研習會。本研究計畫執行團隊迄今已執行完畢第三年研究計畫期程，以下依研究目的、理論基礎、研究方法、研究產出、雲端平台、研究成效等分節說明。

壹、 研究目標

依據研究計畫總目標之內容要項、特色與宗旨，本期迄今計畫的目的在各年度具體執行實施工作事項如下分項所示：

第一年：建置國中小原住民網路數位教學模式、建置國中原住民網路數位教學模式、推廣與開課原住民地區中小學文化融入式課程之師資訓培研習會。

第二年：建置國中小原住民網路數位教學模式、建置國中原住民網路數位教學模式、推廣與開課原住民地區中小學文化融入式課程之師資訓培研習會。

第三年：建置國中小原住民網路數位教學模式、建置國中原住民網路數位教學模式

貳、 研究方法

在課程教材與課程的開發上，本計畫以平行鷹架模組式課程開發工法。教材的開發必須兼顧未來的可擴充性。因此，本團隊運用自創的教材開發工法「平行鷹架模組式課程開發工法」(Framework, Parallel, Module for Culturally)其流程分為三階段:1)鷹架開發，2)知識模組化，3)知識融合化。第一階段，鷹架式的開發有四個過程:1) 建立課程架構，2)確定教學主題，3) 確定教學指標，及4)確認原住 民知識及文化。當確定課程鷹架及學習指標後，下一階段是知識模組化，依據學習主題 及指標，收集相關的知識內容，再同時進行原住民知識模組化及現代科學知識模組化。 最後是融合模組化，把模組化後的知識，進行實證查核及設定文化安全準則，並合併為整體性的混合模組(holistic hybrid teaching module)成為一個新的模組單元。

其實際研究方法上工具的選定我們採用課前後問卷評量方式來檢測教材與課程的

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有效性與可推廣性，並使用統計應用軟體來計算問卷之結果，其詳細評量方式與統計方式如下說明：

一、研究工具

1. 學習評量

測驗工具共分為三個部分，分別為前測、後測、國小課程喜好度問卷與國中學習態度與認知問卷。

2. 統計方式

本計畫研究團隊開發之評量工具評估學生學習成果，測驗分為三個部份，分別是:健康體位態度(10 題)、健康體位的知識(15 題)及健康體位的行為(10 題)。施測時間 40 分鐘，採用成對 t 檢定來比較實驗組學校及控制組學校的分別。

本研究採用庫李信度(Kuder-Richardson reliability) 20 號公式，由學者 G.F. Kuder 和 M.W. Richardson 所發表提出，此係數適用於「對或錯」之是非題。

庫李信度公式表:

$$KR_{20} = (\frac{k}{k-1})(1-\frac{\sum pq}{S^2})$$

k：為整個測驗的題數

p：為每題答對百分比

q：為每題答錯百分比

S2：測驗總分的變異量

3. 雲端平台

為求本教材在使用上能符合可重用、易取得、可互用、可耐用等四項特性訴求，並為以利國中小數位教學摸式，本計畫協同相關領域專家與技術人員設計與建置國中小數位學習與教學平台(國立網路平台網址：http://210.61.2.8/elearning/index.php ；國中網路平台網址：http://210.61.2.8/secondary/)。

二、研究對象

本計畫實驗課程自第一年至第三年國中小實驗課程授課對象，主要以原鄉國小五年級以及國中七年級學生為對象，迄今參與本實驗課程學生人數已達 139 位。

陸、研究成果

102 學年度(上)南排灣族國小數位教學模式實驗課程前後測成對樣本 t 檢定統計分析結果

(n=20)

分量表	前測		後測		t-值（雙尾）	p-值（雙尾）
	平均數	標準差	平均數	標準差		
（健康體位態度）	34.10	8.10	36.35	7.67	0.908	0.375>0.05
（健康體位知識）	10.95	2.72	13.90	2.22	4.03	0.001=0.001***
（健康體位行為）	32.40	6.58	35.45	5.69	1.57	0.131>0.05

註: 合作實驗小學:石門國小、高士國小本部、高士國小牧林分校

103 學年度上學期-國小南排灣族數位學習模式實驗課程前後測成對樣本 t 檢定結果

n=9

分量表	前測		後測		*t*-值（雙尾）	*p*-值（雙尾）
	平均數	標準差	平均數	標準差		
（健康體位態度）	35.77	11.33	40.88	4.98	1.618	*P*=0.144>0.05
（健康體位知識）	10.00	2.91	13.77	2.22	4.648	*P*=0.002<0.05**
（健康體位行為）	38.55	10.54	40.88	5.86	0.666	*P*=0.524>0.05

註：合作實驗小學:屏東縣牡丹國小

本研究旨在以準實驗研究法來探究排灣族國小學童在介入式課程之後，健康知識、態度以及行為上的改變。計畫透過自創的跨文化科學教材開發的新工法「平行鷹架模組式課程開發工法」(Framework, Module, Parallel, FMP for culturally inclusive curriculum)成功開發出了南排灣族國小五年級文化融入式健康與醫療科學實驗課程。課程內容乃結合教育部九年一貫制健體課程內容大綱與在地文化脈絡為主要內容。為求教學的即時性與共備性，以及教材的可重複性，本研究使用數位科技將教材、評量、教學活動整合為連續性網路平台教與學的數位教室。本實驗課程以一學期為期八週之期程進行試教，課程前施於前測，完成課程後施於後測。資料分析工具乃以SPSS 10.0版本作前後測成對樣t檢定。研究結果表示南排灣國小五年級實驗組學生前後測成績比較在健康體位態度與知識上都呈正向顯著至非常顯著的成績表現。相較於控制組的成績表現，實驗組學生總體成績進步程度較控制組明顯良好。

E1: Taiwan Indigenous Cultural Inclusive Health, Environment and Teaching training curriculum

Principal Investigator: Kuo-Yuan Hwa（Amuay Roishazen)[1]

Introduction

The main purpose of our research project in 2nd stage is to investigate the outcome and impact of the new e-platform program, the Taiwan Indigenous Culture Inclusive Health Science Education Program for the 5th grade elementary students. The materials of course were developed based on two core knowledge systems: the first one was from the "empirical science" which examines indigenous traditional knowledge and combines it with modern evidence-based scientific knowledge. We have analyzed the effectiveness of the new course with southern *Paiwan* tribal 5th grade elementary and 7th grade junior high students. To probe into the southern students' learning attitude, learning knowledges and learning behavior.

In our research, the quasi-experimental survey method, included a pre-, post- tests were used with one experimental group and a control one. The data from the survey was analyzed by SPSS for Windows 10.0 version and t-test analyses were performed. The study results are as follows:

1. There are significant differences between the two groups in knowledge learning and enhancing outcome in acquiring health science knowledge among three-tribe experimental groups
2. The results in acquiring healthy attitude and behavior were vary difference since the program only last for 8 weeks. A longer program might be more effective.

METHEODOLOGY

A. Framework

The culture inclusive health science education program contains two various knowledges, modern health science and Taiwan indigenous culture knowledges. Meanwhile, the researchers developed and offered the culture inclusive health science curriculum and content of materials, also the assessment of learning performance between pre- and post-test and questionnaires. Other than that there was a teacher training before the course.

B. Participants

The target participants of the education program were *Paiwan* tribe 5th grade elementary and junior high schools students in Taiwan indigenous district. The education program had been carried out since 2014 to 2016. All students participated in an eight-week curriculum for culture inclusive health science education in the semester. The preparation of the program offered a practical training lesson. In the training, the teachers be requested to integrate model health science knowledge and tribal culture knowledge into the teaching tactic and be supposed to make use of the resource (elders' life experience) from the tribal community.

C. Material

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The textbook material in this study consists of 8 units (as shown in figure 2), and contained of two scale knowledges, modern health science knowledge and indigenous culture knowledge. In the aspect of the content of materials, the textbooks are guided to its destination by two strategies. First, in the consideration of literacy competency standards in nature and life learning that Ministry of Education confirmed to revise by the approach of nine - year system, to continue to use the specific health science knowledges that conform to the standards. Secondary, with localization of model health science knowledges that authority supports to, the textbooks are designed to be characteristic of indigenous cultural life experience. That is, in this textbook, cultural experience as examples to illustrate model health science knowledges. Hence, enhancing the literacy and performance in indigenous students learning; on the other hand, enrich students' self-confidence by learning model science.

D. Instrument

Instruments used in this study were designed to survey the literacy of health science learning of indigenous 5th graders in elementary school. Two instruments were used in this study. They were pre- and post-test and questionnaire. The details of each instrument would be discussed as follows:

1) Pre- and post-test

In the study, we selected two classes from each three tribes, one class was selected as a sample (experimental group), and the other was selected as a contrast (control group). The class of sample adopted a series of new curriculum, on the other hand, the class of contrast used old methods in the study, we did pre- and post-test those were conducted to both the groups.

2) Questionnaire

The questionnaire was designed to obtain information of experimental group students' favor to the curriculum after the course. 38 questions would be asked in the questionnaire. 10questions were related to students' learning situation during the course, 10 questions were related to the complexity of the content of the courses, 8 questions were related to the emotion of students during the course, 6 questions were related to the stress mode in the classroom they felt and 4 questions were related to students opinion to the teacher and the courses.

E. Data analysis

For the quantitative data, the researchers employed the Statistical software, SPSS 12.0, was used to analyze the data. Descriptive statistics, independent-samples t tests and paired-samples t tests were used to determine whether the students among three tribes learning performance had different in health, attitude and behavior knowledges.

The descriptive statistic was used in this study include mean score, standard deviation and percentage. In order to determine whether groups are comparable prior to the health science knowledges, independent sample T-test was used to test differences between two groups. And, by using the paired sample T-tests in this study, we concluded whether or not the curriculum has improved the efficiency of the students from the comparison with performance between pre- and post-test in experimental group.

Result

Time: March-June, 2016

Participants: 11 5th grade students, Mudan Elementary School, Pintung County

n=9

scales	Pre-test		Post-test		*t*	*p*-value (2-tails)
	M	***SD***	***M***	***SD***		
Health attitude	35.77	11.33	40.88	4.98	1.618	*P*=0.144>0.05
Health knowledge	10.00	2.91	13.77	2.22	4.648	*P*=0.002<0.05**
Health behavior	38.55	10.54	40.88	5.86	0.666	*P*=0.524>0.05

Time: March-June, 2016

Participants: A=11 7th grade students, Mudan Junior High School (experimental);
B= 29 7th grade students, Shitsi Junior High School (control)

Scale		Pre-test		Post-test		*n*	*t*	*P*-value (2-tails)
		M	SD	M	SD			
Science knowledge	A	38.31	0.08	48.06	1.49	16	2.68	*P*=0.017<0.05**
	B	29.48	1.01	34.21	1.08	29	2.52	*P*=0.017<0.05**
Culture knowledge	A	62.20	1.08	69.13	1.41	16	3.60	*P*=0.003<0.05**
	B	58.52	0.95	63.21	1.14	29	2.611	*P*=0.014<0.05**