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| **APPLICATION FOR**  **SENIOR SPECIALIST TRACK RESEARCH FUND 2020** |
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| **AIM** |
| The Senior Specialist Track Research Fund (SSTRF) aims to build a culture of research in MOE and support the growth of Senior Specialists as thought leaders through providing opportunities for:   * Leading and participating in research projects * Engaging in cross-divisional research collaborations * Communicating research findings and experiences * Informing policy and practice through research |
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| **ELIGIBILITY** |
| The following officers are eligible to apply for the SSTRF:   * All Senior Specialists |



**PART I: GENERAL INFORMATION Application: ☒New ☐Revise**

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| 1. **Principal Investigator** | Lawrence WEE Loo Kang (Lead Specialist) |
| 1. **Division / Branch** | Educational Technology Division / Technology for Learning |
| 1. **Research Title** | Designing Interactive e-Assessment Test Items using Open Source Tools |
| 1. **Research Dimension** | Curriculum, Assessment, Pedagogy and Instruction |
| 1. **Research Area** | Assessment |
| 1. **Target Level** | Secondary |
| 1. **Student Ability** | ~~Special/~~Express/Normal Academic/Normal Technical |
| 1. **Total Cost of Research** | **$** 52 823.00 |

**PART II: RESEARCH DETAILS**

1. **RESEARCH ABSTRACT** *(Provide a 200 word summary about your research proposal)*

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| Ministry of Education Singapore (MOE) through the Singapore Examinations and Assessment Board (SEAB) has a 10-year national e-assessment plan from 2013 to 2024, to progressively include more subjects and across levels (Primary, Secondary and Pre-University). MOE/SEAB is proposing to provision electronic School-based Assessment (e-SBA) for Mid-Year and Preliminary Examinations for graduating cohorts from 2022. In the interim, schools could choose to rely on existing workarounds, such as relying on video-viewing devices with pen-and-paper mode. In the long run, schools would require an electronic assessment platform that allows them to provide practice e-SBA for graduating cohorts.  This proposal addresses this gap by experimenting and exploring TAO[[1]](#footnote-0) for piloting practice e-SBA with O-Level Exercise and Sports Science (ESS) for theory paper 1. Teachers will be supported by MOE HQ officers in designing interactive item types. ESS was selected as our focus subject because 2019 is the first year that ESS will be deploying Paper 1 in e-mode at the National e-Exam level. MOE HQ officers offer rich experience from piloting the e-mode and have developed test items from 2017. TAO is selected due to its rich array of interactive item types that ‘matches’ the common set of items in most e-assessments.  TAO is the leading open source assessment platform used by the Program for International Students Assessment (PISA) in 60 countries. We hope to add ESS simulations, inside TAO, a feature that we speculate, would promote critical thinking in ESS and support interactive assessment types designed using an open source tool called Easy JavaScript Simulation (EJSS) toolkit.  Thus, the three aims are:  Aim 1 (Develop EJSS Plugin for TAO)  To develop a new EJSS plugin for TAO, and allow Exercise and Sports Science simulations to run inside TAO as a virtual laboratory to support richer assessment item types, in consultation with Officers from the Physical, Sports & Outdoor Education Branch (PSOEB), Student Development Curriculum Division (SDCD).  Aim 2 (Explore TAO as a secure e-SBA platform)  To install TAO on a secure web server where the degree of cybersecurity that TAO affords for secure e-SBA will be evaluated and addressed if needed.  Aim 3 (Explicate learning points of designing e-assessment interactive item types)  To derive a set of learning points through pilot testing in 1 school as the practice session for graduating cohorts, through observation of students using the interactive item types and teachers in creating and drafting the interactive item types, in consultation with Officers from the Physical, Sports & Outdoor Education Branch (PSOEB), Student Development Curriculum Division (SDCD). |

1. **RESEARCH OBJECTIVES** (*State the objectives of the research proposal clearly and succinctly in order of priority)*

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| Research Objectives  RO1: To create a new plugin[[2]](#footnote-1) [[3]](#footnote-2) for the insertion of existing Easy JavaScript Simulation[[4]](#footnote-3) (EJSS) into the TAO examination platform with consultation from Professor Félix J. García Clemente[[5]](#footnote-4), cybersecurity computer scientist and creator of EJSS toolkit.  RO2: To surface degree of cybersecurity and implementation considerations in the use of TAO platform for interactive item types for electronic school-based assessment (e-SBA).  Background: cybersecurity ensures the integrity of the e-SBA system and student data protection and is a key consideration to the adoption of any assessment platform for e-SBA. Thus, RO2 is necessary.  RO3. To pilot/trial crafted interactive test/exam items in 1 school to understand the student user experience and with teachers to better understand their test design experience and views of students user experience. |

1. **RESEARCH QUESTIONS** *(State the research questions that your proposal seeks to address)*

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| Why ESS[[6]](#footnote-5)?  O-Level ESS Paper 1 national examination is a computer-based assessment that aims to provide a more dynamic and authentic contexts instead of using still pictures or descriptive passages in a pen-and-paper format. Visual stimuli on sports/exercise content will be used to test the understanding, application and analysis of the students in the national examination. If the project is supported, we speculate other subjects (.e.g, sciences) will be able to benefit from our research artefacts such as the use of TAO for e-SBA and our ESS item design as examples or templates for other subjects.  Why open source tools?  Open source tools, like TAO and EJSS, give the freedom to do our own customization[[7]](#footnote-6) because we can control the source code and it would be open and flexible for the future. Open sources allow experimentation and exploration by researchers at the preliminary stage of any new development.  What TAO offers for ESS?   1. Authoring Simple and Advanced Items[[8]](#footnote-7), TAO supports all Question and Test Interoperability (QTI) interaction types. From multiple-choice to technology enhanced items (TEIs) you can create what you need. it also supports importing existing QTI items or tests directly into TAO if you do not want to create from scratch. Other than PISA, Cambridge Assessment has been embracing QTI as an international standard for electronic assessment (formative and summative) since 2004[[9]](#footnote-8). 2. Computer Adaptive Testing, TAO comes with a general-purpose CAT application programming interface (API) that enables you to plug-in your own proprietary or Open Source CAT engine. This way, you have full flexibility and control over which adaptive test algorithms you want to use. 3. Deliver Tests to Mobile Devices, all QTI interaction types are fully compatible with mobile devices. Conduct online tests on student iPads, Android Tablets or laptops securely, by combining TAO with lock-down browsers such as the free open source Safe Exam Browser. 4. Manage Test-Takers Enter candidate data directly into TAO, or import it from a CSV file. Then, verify test-takers’ identity with usernames and passwords through TAO, or via third party applications that support the OAuth standard, enabling single-sign-on (SSO) through an LMS like Moodle or Student Learning Space. 5. Manage and Control User Access, define user profiles based on roles and responsibilities. Assign and restrict access to user functions as well as item and test content, ensuring your test data is fully protected. 6. Scale from Classroom to Nationwide, TAO’s test delivery engine is built on a NoSQL data storage model, enabling you to scale with confidence from classroom to nationwide. If a test is unexpectedly interrupted, TAO’s built-in fail-safe ensures that candidates resume the test exactly where they paused.   Thus, our research question is:  **What are the insights on the usefulness of open source tools such as TAO and EJSS in the creation of Exercise and Sports Science e-assessment interactives for electronic school-based assessment in Singapore?**  What next after this project?  As more subjects (Ordinary Level History and Normal Technical Science by 2024) will go e-Exams, the test items and the platform can be scaled to other subjects and for more schools.  Supported in the Long Run  ETD could possible be the division to support this platform and be the leader of open source tools. Syncing through (ADF) with SLS will allow for single login.  Why not let SLS do e-SBA?  SLS was built from scratch by a vendor and roll out to all schools in 2019 and is still trying to build up its capabilities, fix bugs and ensure interoperability across different devices for supporting teaching and learning and the funds are limited to these features. The MOE team and the vendor are having a challenging time with current build request queue, and meeting timeline and cost. It might cost a lot and difficult technically as SLS is not built conforming to Learning Tools Interoperability[[10]](#footnote-9) (LTI) international standards and to suddenly request for e-Examination features to be built on a Teaching and Learning platform, can be rather impossible by 2022. |

1. **UTILITY OF RESEARCH & DELIVERABLES** *(State how your proposed research will improve existing policy and/or practice)*

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| Utility  RO1 and RO3: To understand the design considerations of interactive item types in the context of Exercise and Sports Science comparable to sample PISA 2015 Test Questions[[11]](#footnote-10).  RO2: To expand MOE thought leadership on secure open source and Learning Tools Interoperability[[12]](#footnote-11) (LTI) compliant e-assessment platform such as TAO. This could bring about MOE centrally deploying TAO for e-SBA for all non-graduating students in all schools in a cost-effective and sustainable manner.    *Figure 1: PISA 2015 Running in the Hot Weather Questions*  Deliverables  RO1: To design two EJSS interactive test items administered in TAO as a prototype for e-SBA for the subject of Exercise and Sports Science.  RO2: To install TAO on a secure web server and develop a new plugin to insert EJSS easily into TAO.  RO3. To pilot/trial crafted interactive test/exam items in 1 school to understand the student user experience and with teachers to better understand their test design experience and views of students user experience. This will be conducted through quantitative (survey and test results analysis) and qualitative (interviews) measures. |

1. **RESEARCH METHODOLOGY AND DESIGN** *(Provide a brief description of your intended research design, sampling, and methods)*

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  | | --- | --- | |  | Qualitative and Quantitative methods | | *Research purpose* | Exploratory research where the research purpose is to generate insights about discovering the degree to which ESS was able to perform the role of a e-SBA using TAO and EJSS, degree of cybersecurity and implementation considerations in the use of TAO platform for interactive question types for school-based assessments. | | *Data needs* | * Student-user data (survey, interviews, scores in TAO), Teacher-user data (survey, interviews) * Server data, cybersecurity expert scans and attacks | | *Data sources* | * HQ officers, teachers, students * Server logs, cybersecurity expert consultation | | *Data collection form* | * Discussions,Open ended interviews, surveys and observations   + insights on what other dynamic and authentic contexts on ESS could be developed for paper 1   + insights on the user experience and what else can be improved on the ESS paper 1   + insights on what else need to be need to be done to enable other subjects to come onboard the open source tools platforms | | *Sample* | * One cybersecurity expert * Small size typically 3-5 teachers * Exercise and Sports Science students in one e-SBA in one school | | *Data collection* | * Reports generated by cybersecurity expert * Test results, user interactions with TAO | | *Data analysis* | * TAO and server log files * Informal recommendations by cybersecurity expert * TAO built-in test analysis and user data | | *Inferences* | * Tentative recommendations | |

1. **IMPETUS FOR RESEARCH** (*Provide a brief review of the literature or case for support of no more than 1000 words for your research proposal. Append as a separate Annex if necessary)*

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| The iCAP e-Assessment Working Group is exploring alternatives in supporting electronic School-based Assessment (e-SBA) for non-graduating cohort. PI is proposing to explore TAO, a customisable and popular and full-featured e-platform (used in administering PISA in 60 countries as well as a growing list of adopters[[13]](#footnote-12)) with EJSS serving as interactive virtual laboratory to support test items. Other alternatives such as bespoke assessment platform and Commercial-Off-The-Shelf (COTS) platforms, are generally less customisable and a lot costlier to add new features due to the proprietary business model.  This SSTRF project is therefore well positioned to provide findings to support iCAP’s work on e-Assessment and could potentially provide disruptive technology ideas[[14]](#footnote-13) and a small pool of Exercise and Sports Science interactive test items for e-SBA settings. |

1. **DETAILS OF RESEARCH PROJECT TEAM** *(Provide details of your research team)*   
   Is this a Cross-Division / Branch team? Yes ☒No

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Role** | **Name** | **Designation** | **Branch/**  **Division/**  **Organisation** | **Contact details: E-mail** |
| **1** | PI | Lawrence Wee | Lead Specialist | Technology for Learning/ ETD / MOE | lawrence\_wee@moe.gov.sg |
| **2** | Co-PI | Jean Phua | Lead Specialist | Technology for Learning/ ETD / MOE | jean\_phua@moe.gov.sg |
| **3** | Collaborator | Félix J. García Clemente | Professor | Department of Computer Engineering and Technology/ University of Murcia / Spain | fgarcia@um.es |
| **4** | Collaborator | Cleve Chia | Senior Physical, Sports & Outdoor Education Officer | Physical, Sports and Outdoor Education Branch / SDCD / MOE | cleve\_chia@moe.gov.sg |

**Project Implementation Schedule** (Gantt chart format)

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Milestones** | **Month** | | | | | | | | | | | |
| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Install TAO and upgrade to the latest version, add functionality | √ | √ |  |  |  |  |  |  |  |  |  |  |
| Develop EJSS plugin for TAO to allow embed or upload (more secure) of simulations. | √ | √ |  |  |  |  |  |  |  |  |  |  |
| Design interactive e-test items with officers from PE Branch |  |  | √ | √ | √ | √ | √ |  |  |  |  |  |
| Cybersecurity testing and attacks by expert. Patches and recommendations to be reported. |  |  |  |  | √ |  |  |  |  |  |  |  |
| Improve EJSS and TAO surface by the project team |  |  | √ |  | √ | √ | √ |  |  | √ |  |  |
| Prepare for field testing of e-SBA with EJSS test items |  |  |  |  |  |  |  | √ | √ | √ |  |  |
| Prepare report |  |  |  |  |  |  |  |  |  |  | √ | √ |

**PART III: FUNDING DETAILS**

1. **Summary of Total Research Grant Required**

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| --- | --- | --- | --- |
|  | **Tranche 1**  **Jan to Mar 2020**  **($)** | **Tranche 2**  **Apr to Dec 2020**  **($)** | **Total**  **($)** |
| **Manpower** | $ 7,706.00 | $43,117.00 | $50,823.00 |
| **New equipment/facilities** |  |  |  |
| **Materials/consumables** |  |  |  |
| **Training/computer software/other misc. costs** | $2,000.00 | 0 | $2,000.00 |
| **Total ($)** | $9,706.00 | $43,117.00 | $52,823.00 |

1. **Funds Required for Tranche 1 Jan to Mar 2020**

**Manpower Costs+** (for ad-hoc, part-time staff only)

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| --- | --- | --- | --- | --- |
| **Staff Grade &**  **Academic qualification** | **Rate ^** | **Duration** | **Total Cost @** | **Justification** |
| Full GCE 'A' Level Certificate | $74 per day X 17% employer CPF contribution = $86.58 | 89 days | $ 7,705.62 | To design the simulations and populate questions into TAO platform |
| **Total ($)** |  |  | $ 7,706.00 |  |

+ for Relief Executive and Administrative Staff (REAS) engaged under the Casual Employment Framework (CEF, wef 1 Jul 2017), contract duration will be capped at less than 3 months (defined as less than 90 calendar days), i.e. cannot exceed 89 calendar days.

^ Daily rates are computed as follows: Degree ($143) / Polytechnic Diploma ($92) / Full GCE 'A' Level Certificate ($74) / Nitec in Business-related discipline ($69).

@ Total cost must include 17% employer CPF contribution. (Consult your Division Finance Rep when working out the rates for manpower)

*For example: If PI want to employ a ‘A’ level qualification Research Assistance for 3 months, the daily rate payable is $74 per day for a duration of 89 days. The total amount will be $7705.62.*

For other employment variations, please refer to the circular [EDUN N-03-42-196-V1 REVISIONS TO THE APPOINTMENT TERMS FOR CASUAL EMPLOYEES](http://intranet.moe.gov.sg/hronline/MOECirculars/2017/PA_07_17_Revised_REAS_Circular.pdf).

All PIs of projects must comply with current procurement procedures for the use of vendors and recruitment of Research Assistants for their projects.

1. **New Equipment/ Facilities Costs\***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Item Description** | **Quotation#**  **Attached**  **on Page No.** | **Unit Price** | **Quantity** | **Total Cost** | **Justification** |
| **Total ($)** |  |  |  |  |  |

\* SSTRF should be used to purchase equipment only if there is no other avenue to obtain the equipment. Any proposed purchase needs to be fully justified.

# For each item requested, at least one vendor’s written quotation should be attached. To facilitate identification of each item’s cost, please write clearly the item number, say ‘Item 1’, on the written quotation and highlight the item description, unit cost and total cost. The proposed cost must tally with quoted figure. Computer software is to be classified under Miscellaneous Costs.

1. **Costs of Materials/ Consumables**

|  |  |  |  |  |
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| **Item Description** | **Unit Price** | **Quantity** | **Total Cost** | **Justification** |
| **Total ($)** |  |  |  |  |

1. **Training / Computer Software /Other Miscellaneous Costs©**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Item Description** | **Unit Price** | **Quantity** | **Total Cost** | **Justification** |
| Web server | $ 2,000.00 | 1 | $ 2,000.00 | To host the TAO platform and EJSS interactives |
| **Total ($)** | $ 2,.000.00 |  | $ 2,000.00 |  |

© The developmental costs component for each proposed SSTRF application budget will be capped at $70 000. All ICT-based learning resources developed under a SSTRF project should be designed to be able to be hosted in the Student Learning Space (SLS) for sustainability of impact on learning. For other ICT-based resources developed for teachers or other internal stakeholders, the design needs to consider long term sustainability of the project.

Owner divisions of projects that have a long implementation phase beyond the 1-year SSTRF project timeline must accept the undertaking to bear the follow-up costs for the subsequent implementation and scaling-up phases.

**Funds Required for Tranche 2 (Apr to Dec 2020)**

**1. Manpower Costs**

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| **Staff Grade &**  **Academic qualification** | **Rate** | **Duration** | **Total Cost** | **Justification** |
| Full GCE 'A' Level Certificate | $ 74 per day X 17% employer CPF contribution = $86.58 | 9 month  (267 days) | $23,116.86 | To design the simulations and questions into TAO platform |
| PhD | $1,000.00  (include honorarium ,air ticket and hotel and transport) | 1 month | $20,000.00 | To train project team in the design of interactive assessment virtual laboratory,  develop and add features on a plugin for TAO to incorporate EJSS interactions  Only Professor Felix knows how to customize EJSS editor (he is the creator) to work in TAO with for data analytics and setting synchronous randomised initial conditions, without him, the project will be difficult |
| **Total ($)** |  |  | $43,117.00 |  |

**2. New Equipment/ Facilities Costs**

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| --- | --- | --- | --- | --- | --- |
| **Item Description** | **Quotation**  **Attached**  **on Page No.** | **Unit Price** | **Quantity** | **Total Cost** | **Justification** |
| **Total ($)** |  |  |  |  |  |

**3. Costs of Materials/ Consumables**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Item Description** | **Unit Price** | **Quantity** | **Total Cost** | **Justification** |
| **Total ($)** |  |  |  |  |

**4. Training / Computer Software /Other Miscellaneous Costs**

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| **Item Description** | **Unit Price** | **Quantity** | **Total Cost** | **Justification** |
| **Total ($)** |  |  |  |  |

**PART IV: DECLARATION**

We declare that the facts stated in this application and the accompanying information are true and that this is an original proposal.

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|  | Name |  | Signature |  | Date |
| Principal Investigator: | Lawrence Wee Loo Kang |  | C:\Users\moe-09615h\AppData\Local\Microsoft\Windows\INetCache\Content.Word\signature.png |  | 30/05/2019 |
| Co-Principal Investigator: | Jean Phua |  |  |  | 30/05/2019 |
| Collaborator: | Félix J. García Clemente |  |  |  | 30/05/2019 |
| Collaborator: | Cleve Chia |  |  |  | 30/05/2019 |

**PART V: EVALUATION AND ENDORSEMENT**

This section is to be completed by the *Divisional Representative*. Please tick the appropriate field.

|  |  |  |
| --- | --- | --- |
|  | **Yes** | **No** |
| **Merit of the Project** | | |
| Project objectives are clearly stated. | √ |  |
| Deliverables are clearly stated. | √ |  |
| Project is relevant to the Division. | √ |  |
| Project is relevant to MOE and the Singapore Education System. | √ |  |
| Project is timely with respect to applications. | √ |  |
|  | | |
| **Project’s Potential to Produce Useful Results** | | |
| Teaching and learning | √ |  |
| Advancement of knowledge or core technology | √ |  |
| School organisation and education policy |  |  |
| Others (please specify) | | |
|  | | |
| **Reasonableness of Resources Requested** | | |
| Quantity and type of resources requested are reasonable. | √ |  |
|  | | |
| **Reasonableness of Schedule of Project Implementation** | | |
| Schedule of project implementation is achievable i.e. lead time for procurement of equipment and recruitment of manpower, if any, has been taken into account. | √ |  |

**ADDITIONAL COMMENTS, IF ANY**

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| This project aims to develop a new plugin to insert Exercise and Sports Science simulations into the TAO examination platform, which is an open source assessment platform that has been used to administer PISA.    If the new plugin is successfully developed and the project team is able to determine the relevance and usefulness of this new plugin with accompanying insights to share with the fraternity, MOE would have gained new knowledge about the creation of interactive item types in e-Assessment with ready artefacts that could be uploaded and shared with teachers and students. |

**COMPLETED BY: DIVISIONAL REPRESENTATIVE**

|  |  |  |
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| Name: | Signature: | Date: |
| Low Tan Ying |  |  |

**CLEARED BY: BRANCH HEAD**

|  |  |  |
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| Name: | Signature: | Date: |
| Suraj Nair Venugopal |  |  |

**ENDORSED BY: DIVISIONAL DIRECTOR**

|  |  |  |
| --- | --- | --- |
| Name: | Signature: | Date: |
| Aaron Loh |  |  |

1. <https://www.taotesting.com/> [↑](#footnote-ref-0)
2. <https://en.wikipedia.org/wiki/Plug-in_(computing)> [↑](#footnote-ref-1)
3. <https://gitlab.com/ejsS/tao-interaction> prototype EJSS-TAO interaction plugin [↑](#footnote-ref-2)
4. <https://www.um.es/fem/EjsWiki/> [↑](#footnote-ref-3)
5. <https://webs.um.es/fgarcia/miwiki/doku.php?id=home> [↑](#footnote-ref-4)
6. <https://www.moe.gov.sg/docs/default-source/document/education/syllabuses/physical-sports-education/files/2018_olevel_exercise_and_sports_science_syllabus.pdf> [↑](#footnote-ref-5)
7. <https://www.accelerate.taotesting.com/edk-uses-tao-to-ensure-consistent-nationwide-learning-standards> [↑](#footnote-ref-6)
8. <https://www.taotesting.com/solutions/features/> [↑](#footnote-ref-7)
9. <https://www.cambridgeassessment.org.uk/Images/140026-annual-report-04-05.pdf> [↑](#footnote-ref-8)
10. <https://en.wikipedia.org/wiki/Learning_Tools_Interoperability> [↑](#footnote-ref-9)
11. <http://www.oecd.org/pisa/PISA2015Questions/platform/index.html?user=&domain=SCI&unit=S623-RunningInHotWeather&lang=eng-ZZZ> [↑](#footnote-ref-10)
12. <https://en.wikipedia.org/wiki/Learning_Tools_Interoperability> [↑](#footnote-ref-11)
13. <https://www.taotesting.com/resources/?fwp_resource_categories=all&fwp_tags=case-study> [↑](#footnote-ref-12)
14. <https://greatperformersacademy.com/entrepreneurs/30-disruptive-technologies-and-ideas-that-will-transform-industries> [↑](#footnote-ref-13)