



## **An Experimental Approach to ICT for Climate Change Awareness in Myanmar**

**Benjamin K. Blevins<sup>1\*</sup>, Nyi Nyi Htwe<sup>1</sup>, Shree Kumar Maharjan<sup>1</sup>  
and Shinji Kaneko<sup>1</sup>**

<sup>1</sup>*Graduate School for International Development and Cooperation, Hiroshima University, 1-5-1 Kagamiyama, Higashi-Hiroshima City, Hiroshima, 739-8511, Japan.*

### **Authors' contributions**

*This work was carried out in collaboration between all authors. Author BKB led the drafting of the paper and provided the statistical analysis along with author NNH, SKM designed the study under the supervision of author SK. All authors contributed to the literature review and protocol of the study. All authors read and approved the final manuscript.*

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### **ABSTRACT**

The study explores the introduction of ICT into the classroom by conducting a randomised controlled experiment (RCT) among secondary schools in urban Myanmar. Using a lecture on climate change awareness, 942 students in five schools in Yangon and Mandalay participated in the experiment. For treatment groups, the lecture was video-based, with the teachers simply providing support to the contents of the video. In contrast, the teachers in the control groups presented the content of the video lecture without the video-aid. Student learning outcomes for those in the treatment group resulted in a mixture of outcomes divided on gender lines. The study suggests that ICT can simultaneously benefit certain students while impeding others, and thus should not be treated as a panacea to improve learning outcomes.

**Keywords:** *ICT; Myanmar; primary school; climate change; RCT; difference-in-differences.*

\*Corresponding author: Email: [benblevins@hiroshima-u.ac.jp](mailto:benblevins@hiroshima-u.ac.jp);

## 1. INTRODUCTION

Education and technology have an inseparable history in an increasingly globalised society and yet one that is asymmetric in contributions to one another. Although education is the gateway to all technologies, either through self-study or formal education, technologies do not readily facilitate advancements in pedagogy. Information and communication technology (ICT) in the form of computers, the internet, and digital media, is now central to the globalized economy and yet their integration into education, especially at the primary and secondary school levels is often awkward or incomplete. The phenomenon is noteworthy for schools in countries with growing economies, transitioning from low- to middle-income status, such as in the Republic of the Union of Myanmar, hereafter Myanmar, with recent access to stable electricity, computers, and internet, but which have not yet applied the strengths of ICT to enhance the pedagogy of the student curriculum.

To test how ICT might play a role in the enhancement of learning outcomes, the paper presents the finding of a series of experiments conducted at five secondary schools in Yangon and Mandalay, Myanmar in 2017. The experiment used freely available internet content, including videos and translation software to develop a lecture on climate change awareness. The experiment presented a lecture on climate change to two groups of students, with the treatment group receiving a teacher-supported video lecture, while the control group received the content of the video lecture, presented solely by a teacher. The selection of climate change awareness for the lecture stemmed from two considerations: first, it was not included in the school's existing curriculum. The choice allowed the researchers to present a topic with rich scientific literature that was simultaneously relevant to the students' lives, with overlapping themes in economics, politics, and the environment. Secondly, Myanmar will likely be disproportionately affected by climate change, given both its geographic position and its more limited economic resources to dedicate to climate change mitigation and adaption [1–3]. The results of the experiment suggest a difference in results based on gender with measured improvements to boys scores in the treatment group and measurably worse outcomes for girls in the treatment group.

## 2. ICT FOR EDUCATION

In recent decades, ICT has been integrated into virtually every sector of the modern economy including health, agriculture, business, infrastructure development, education, and tourism [4–8]. The power of ICT is due to its overwhelming ability to preserve, analyse, present, and share information more efficiently, affordably, and faster than any previous time in human history. As the benefits of ICT integration in education can be significant, various researchers have sought to track its progress from the primary school level to universities [5,9–11]. As examples, the use of ICT in education helps to enrich the knowledge and understanding of students and teachers such as by allowing self-paced learning, learning by trial and error, and by accessing a wide range of teaching-learning materials, all of which enhances direct and indirect/online interactions and active participation of the students and teachers.

Considering the potential benefits for the enhancement of the teaching-learning process by integration of ICT, it is no surprise that computers are now found in schools worldwide. As with any technology, specialized skills are often required before the benefits of the technology can be felt. Before the requisite skills are gained, interested parties may feel disenchanted or disappointed as the benefits of ICT are not so easily acquired. This can also be true for the application of ICT into the classroom. Studies have reported that without the proper training, computers can sit idle or may not be brought to the fullest potential for aiding learners, often through insufficient teacher training on how to access the benefits of the new technology [12–14]. Indeed, some scholars have noted the negative impacts of ICT in the classroom [15,16]. As with any new technology, the benefits of adoption can also be accompanied by negative externalities. These externalities need to be factored into the cost-benefit equation either at the level of the individual schools or with the policy makers.

The situation of underutilized ICT in the classroom is precisely what the authors of this paper encountered for the schools visited in Myanmar. In each school, computers and other equipment such as video projectors and sound equipment were available and yet sat idle during most of the school year. Both the principals and teachers were interested in exploiting the benefit of ICT but did not know what was available freely

on the internet and how to incorporate this knowledge into the classroom.

### 3. EDUCATION IN MYANMAR

The role of education in present day Myanmar is deeply entwined with the rich and complex history of the territory. From the outer edge of the greater Himalayan mountain range in the north to the Ayeyarwady Delta in the south, are over 135 ethnic groups speaking over 100 languages. The Bamar people comprise roughly 70 percent of the population and have dominated the political and economic landscape from the age of dynastic kingdoms in the ninth century of the common era to the present day. Other major ethnic groups include the Chin, Kachin, Kayah, Karen, Mon, Rakhine, and Shan, each of which has clashed with the Bamar majority seeking greater independence and autonomy. The only major disruption to the Bamar rule came from the British imperial forces in the mid 19<sup>th</sup> century to the mid 20<sup>th</sup> century. A century of British rule brought with it dramatic reforms and new social and political hierarchies, which still shape the country to the present day. Following the ousting of the British, Myanmar's military forces took control of the country forming a political junta. Decades of mostly peaceful struggle from the civil and monastic communities ensued, culminating in major reforms in 2011 that transferred most government function from the military junta to a civilian government.

Constitutionally, all children in Myanmar are guaranteed the right to free and compulsory primary education, consisting of the first five years of education. However, due to insufficient government funding, universal basic education is not yet achieved with roughly 10 percent of boys and girls still not attending school, and for secondary school, the rates are around 40 percent [17]. Three types of schools are found in Myanmar: monastic, government, and private. Government schools comprise the vast majority of the primary and secondary schools, with private and monastic schools catering to a small percentage of the population. Monastic schools cater to three percent of the school-age children [18], usually among the most economically disadvantaged, but given their long historical presence, these schools are also important politically and culturally. These schools primarily teach the national curriculum along with after-hours Buddhist teachings. They rely on a combination of charitable donations and government funds to support their operational costs, however, these funds are often insufficient

[18]. The primary consequence of this lack of funding in Monastic schools is low teacher retention. When teachers have gained enough competence to pass the national exam, these teachers often leave for teaching positions in government schools which offer better payment. Of the 1,500 monastic schools in Myanmar, 70 percent are primary schools and the remaining 30 percent is secondary schools. In contrast, private schools exist over 45,000 across the country and they are primarily providing education to secondary school students.

There are different focuses of ICT integration in education. However, the primary interest of this paper is to measure the effectiveness of video supported lectures on student learning. The video chosen for this study is on how climate change impacts biodiversity, which was downloaded from the internet and was translated and subtitled into the Myanmar language and presented in the selected schools.

### 4. METHODOLOGY

#### 4.1 Selecting the Subject

Prior to data collection, in order to gain the schools' support, the aims and methodology of the project were explained to whom? in the local language, in addition to the identification and hiring of the research support personnel at each target school. Furthermore, both teachers and students were sensitized with the purpose and requirements of their participation in the data collection process for this study.

#### 4.2 Preparing the Contents of Analysis

The video selected was a short movie clip, 12 minutes in length, about the global warming and climate change, designed for secondary-school children. As this study focuses on climate change awareness, content was selected based on the suitability for the secondary-level students. As the purpose of this study is to test content that could be accessed by teachers for their lessons, the video on climate change was obtained using free content on the internet, including the software for subtitling the video into Burmese. In contrast, a customised video may have delivered stronger results, but the possibility of replication by local teachers for various subjects, would be quite unlikely and therefore not appropriate for this paper. Ideally, teachers should be able to duplicate the type of video-lecture used in this case study to enhance the learning experience of their students. For all the schools in Myanmar, at

least one teacher had a high level of English language ability, enabling the school in question to access the content online and to produce the learning material by adding subtitles for the students as part of their regular curriculum.

### 4.3 Preparation of Survey Questionnaires

The survey questionnaires were divided into two parts: part one consists of ten questions capturing information on student characteristics, and part two contains 30 questions measures the students' level of comprehension about the lecture, including six memorized questions. The memorization questions were designed to measure how effectively the students retained short-term information from the lecture, with and without the video aid. The personal and socio-economic questions were included in the questionnaire in order to provide control variables for later analysis, such as age, gender, and family background. To address the internal consistency of the questionnaire, the Cronbach's alpha test was run, with all questions scoring higher than 0.70. As this coefficient represents the threshold for acceptable inter-correlation in social science research, the research team proceeded with the experiment [19].

Surveys were conducted at four schools in Yangon and one in Mandalay, selected at random from a Ministry of Education (MOE) master-list. In total, data from 942 students were collected (47 percent female). The four schools in Yangon are publicly operated as basic education high schools (BEHS) while the fifth one in Mandalay is a monastery school.<sup>1</sup> However, all the schools are taught the same curriculum under the guidelines and national curriculum of the MOE.

The respondents (students) were required to take two tests, a pre-test and post-test, comprising identical questions, to compare the efficiency of two different teaching techniques. After the pre-test, the students were randomly divided into two groups to form a treatment group and a control group. Each group received the same lecture using different methods, as described in the section on methodology in this paper. After taking the respective lectures, held simultaneously, both treatment and control groups took a post-test. The rationale for the

simultaneous lectures was to avoid any spill over effects from treated or controlled students sharing their experience of the given lecture, which would potentially bias the results of the test. To minimize the error in the estimation a clustered random sampling approach was applied by dividing students into treatment and control groups according to their pre-test scores. This was done after the pre-test scores were analysed, by randomly assigning students to treatment and control groups from the bottom, middle, and upper third strata of the test-score distribution.

### 4.4 Randomized Control Trials

Starting in the 1990s then rapidly gaining popularity, randomized control trials (RCTs) have become established for utility in the evaluation of empirical research [20–23]. Each of these studies using RCT was aiming to access the benefit of random assignment, a concept that was made clear by statisticians in the early part of the 20<sup>th</sup> century [24,25]. By randomly distributing the treatment, no unobservable characteristics of the treated participants would be linked to their assignment, enabling researchers to be certain that the difference in outcomes between the treated and controlled groups would be the effect of the treatment.

### 4.5 Validity and Limitations

Despite offering a powerful tool to test a given treatment on a population sample, RCT is only as effective as the degree to which the randomization encompasses the target population, any deviation from which increases the error and the validity of the experiment. As is the case for this study, the randomization was conducted within a limited number of schools rather than among the entire school-going population of Myanmar. Therefore the students attending the selected schools likely share characteristics that may be particular to their school, a form of endogeneity bias. Furthermore, RCT alone cannot account for the appropriateness of the treatment given the duration of the experiment. For example, this study is a cross-sectional research experiment that was implemented in a short timeframe, hence reducing the total cost required, but it was limited in measuring effects that may be better captured over a longer duration in time.

Questions of validity also pertain to the findings of the experiment and what they might reveal

<sup>1</sup> The sampled schools were: BEHS 1, Shwe Pyi Thar, Yangon; BEHS 4, North Okkala, Yangon; BEHS 1, Kyee Myin Dine, Yangon; BEHS 6, North Okkala, Yangon; and Monastic High School, Phaung Daw Oo, Mandalay.

about both the participants within the sample frame and the target population outside of the sample frame, respectively accounting for the internal and external validity of the experiment. Internal validity represents the measurable, verifiable link between this study's cause and effect [26]. For instance, in the case of this paper, if ICT on climate change knowledge was introduced into the classroom by way of a video supplement to a lecture, would test scores on the subject be systematically affected? Ideally, this question would be posed by framing the introduction of one variable into a treatment group that was excluded from the control group. This treatment variable would, therefore, be the only possible explanation for the difference in treatment and control group test differences, assuming that the sample size in both groups was adequately large enough to form a normal distribution of test scores. This is, therefore, a question of the study's efficacy within the study population, without explicitly verifying how the effect of the study would relate to populations outside the study frame.

External validity, in contrast, seeks to gauge if the results of the study can be applied generally, to other populations or circumstances. However, external validity cannot be guaranteed [27]. This is true both in the case of RCTs and for observational studies. In the case of this study, external validity would be confirmed if the findings of this paper were reliably duplicated across schools with similar characteristics. However, as the results of this paper will attest, results between schools varied substantially. As such, we can only speculate as to the true effect of the usage or application of video-based lecture aids in the classroom.

## 5. RESULTS

Table 1 shows the summary statistics of the survey conducted in Myanmar for this paper. The study show both groups are not different before the experiment. The similarity of two groups after the pre-test results encourage the use of the difference-in-differences method for the analysis. In general, the average score of treatment group is slightly better than the controlled group. However, since the total score is 27, the difference of two average scores is 0.2 means 0.74% of total test score which is less than one percent which means no greater significance. The one important thing can be seen from Table 1 is that the standard deviation is smaller for the post-test for the treatment group which suggests

that more students are getting middle-level scores. This summary analysis leads us for further advance statistical analysis.

### 5.1 Difference – in Difference (DID) Results

The analysis was conducted using a difference-in-differences method (DID) for all observations within schools. DID is only slightly more sophisticated than a difference-in-means test, however, DID has the added advantage to analyse the statistical significance of a change of with-in group populations. In the case of this paper, DID was used to measure the differences for the scores of boys and girls in both the treated and control groups, for each school, and for each type of question. As such, it can be observed if any of these sub-groups experienced an impact that may have been overlooked when comparing the whole sample.

For the full sample (n=942), the results in Table 2 show that girls in the treatment group scored somewhat worse than the girls in the control group. For the boys, the result was the opposite, with slightly higher scores. As the size of the impacts was small and the results were statistically insignificant, a subset of questions were examined in the test scores. In looking at the memorized questions, a significant result was found. In this subset, boys in the treatment group performed better than the boys in the control group, with statistical significance at (95% CI).<sup>2</sup> From here, further analysis was conducted which showed that if the individual schools might reveal more details. At BEHS 1, Kyee Myin Dine, Yangon it was observed that girls in the treatment group performed worse than the girls in the control group (significant at 90% CI), and boys in the treatment group performed better than those in the control group overall (99% CI).

The results of the experiment demonstrate different outcomes for female and male students at BEHS 1, Kyee Myin Dine, Yangon. For female students, those that participated in the treatment group had significantly worse outcomes than those in the control group. For male students in the treatment group, the scores were significantly better than those in control group. Potential causal factors for these results include a difference in learning approaches but can also include endogenous variables that might result despite random assignment.

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<sup>2</sup> CI refers to confidence interval.

**Table 1. Summary statistics of Myanmar study**

Gender	Control	Treatment	Total				
Male	243	259	502				
Female	230	210	440				
Total score	Overall	Pre-test	Post-test	Control group		Treatment group	
				Pre-test	Post-test	Pre-test	Post-test
Max	27	25	27	25	27	25	26
Min	7	7	16	8	16	7	17
Average	20.43	18.32	22.53	18.23	22.41	18.36	22.61
Standard Deviation	3.490	3.275	2.053	2.914	2.035	2.699	1.643
n	942	469	473	236	237	233	236

**Table 2. Difference-in-differences estimation results, overall and BEHS 1, Kyee Myin Dine, Yangon (School 3)**

	Coefficient	S.E	P-Value
Overall DID result (n=942)	0.073	0.310	0.813
Girls	-0.422	0.405	0.299
Boys	0.493	0.451	0.274
Girls' estimation result for school 3 (n= 71)	-1.864	1.004	0.068*
Boys' estimation result for school 3 (n=107)	2.277	0.838	0.008***

\*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$

## 6. CONCLUSION

This paper presents the findings on the introduction of information and communication technologies (ICT) by way of video-aided lectures on climate change awareness by randomized controlled trials (RCT) in secondary schools in Myanmar. By developing content for classrooms using freely available videos from the internet, in addition to freely available subtitling software, this study tested schools with tools that could be developed on their own accord, adjusted to their particular needs. While urban schools are likely better equipped than rural schools, each of the schools in this study already possessed the hardware necessary for the experiment, including video projectors and audio equipment. However, this might not be the case in rural schools that may lack the same level of resources.

As this study was conducted at multiple schools at different locations in the country, uniformity of the experimental setting was the highest priority to ensure comparability between schools. However, inevitable variations in the experimental setting, including, as examples, teacher and head master commitment to the study, time of day, and overall classroom anomalies such as acoustics and students' desk placement, each represent an added element of statistical error into the experimentation parameters. Despite the effort to minimize

variation in the experimental setting, the presented results may be under or over reported and will require a longer period of experimentation to reduce the error effect.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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## APPENDIX QUESTIONNAIRE

**ID:** \_\_\_\_\_

**Basic Information**

Grade

Gender

Male	Female
------	--------

Birth Year

Do you live with your parents?

(a) Yes, both of them.	(b) One of them (Father/Mother)
(c) No, live with grand parents	(d) No, live with relatives
(e) Others (specify)	

Do you know education of your parents?

(a) Illiterate	(b) Elementary School	(c) Middle School
(d) High School	(e) Graduate	(f) Don't know

Occupation of your parents

<b>Father</b>	<b>Mother</b>
(a) Farming	(a) Farming
(b) Trading	(b) Trading
(c) Construction	(c) Construction
(d) Factory worker	(d) Factory worker
(e) Self-employed	(e) Self-employed
(f) Other (Specify)	(f) Other (Specify)

Total family members

--

Type of the house you live.

(a) Concrete built	(b) Wooden built	(c) Tent
(d) Temporary	(e) Others (specify)	

Do you have access to electricity in your home?

(a) Yes	(b) No
---------	--------

Do you know what carbon dioxide is?

(a) Yes	(b) No
---------	--------

**Questions concerning the lecture**

Have you ever heard about greenhouse gas?

Yes	No
-----	----

Greenhouse gases are (tick the ones)

(a) Carbon Dioxide (CO <sub>2</sub> )	(b) Ozone (O <sub>3</sub> )
(c) Oxygen (O <sub>2</sub> )	(d) Hydrogen peroxide (H <sub>2</sub> O <sub>2</sub> )

Do you think Greenhouse gases are main sources of global warming?

(a) Yes	(b) No
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Burning fossil fuels increased the amount of CO<sub>2</sub> in the atmosphere which consequently raised the sea level.

(a) Yes	(b) No
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The world's carbon dioxide concentration is stable since thousands of years ago.

(a) Yes	(b) No
---------	--------

Arctic and Antarctica are covered by ice bergs.

(a) Yes	(b) No
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What will happen if the average temperature of earth increased 5°C?

(a) People will die	(b) All water will dehydrate
(c) Ocean level will raise	(d) Nothing will happen

Most of the carbon dioxide in our surroundings is absorbed by plants.

(a) Yes	(b) No
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Plants can absorb all carbon dioxide emitted.

(a) Yes	(b) No
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Increased carbon dioxide in the atmosphere can severely damage the earth including plants and animals.

(a) Yes	(b) No
---------	--------

Using nitrogen fertilizers will increase greenhouse gases.

(a) Yes	(b) No
---------	--------

Do you think local activities have global effects?

(a) Yes	(b) No
---------	--------

Light rays from sun come to the earth as Short wavelength radiation or longer wave length radiation?

(a) short wave length	(b) long wave length
(c) both	(d) neither of

What is the difference between atmospheric greenhouse gas effect and gardener's green house?

(a) same	(b) more CO <sub>2</sub> in Atmosphere
(c) more CO <sub>2</sub> in Gardeners house	(d) More hot in Gardener's house

What is the main problem of greenhouse gases now?

(a) No problem at all	(b) The problem of rate of CO <sub>2</sub>
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What is the trend of CO<sub>2</sub> emissions in the atmosphere over the years?

(a) Increasing	(b) Decreasing	(c) Up and Down	(d) Stagnated
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What is the CO<sub>2</sub> emission in recent years?

(a) Same as before	(b) Increasing drastically	(c) Up and Down	(d) decreasing
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Have you heard of Climate Change before?

(a) Yes	(b) No
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What is the full form of IPCC?

(a) Intergovernmental Panel on Climate Change	(b) International Program on Climate Change
(c) International Program on Children's Care	(d) Interested People of Climate Change

As per IPCC, the average global temperature on earth is increased by

(a) 1.1 to 2.9°C	(b) 2 to 5.2°F	(c) None of them	(d) both of them
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What is the worst case scenario of CO<sub>2</sub>?

(a) 2.4 to 6°C	(b) 4.3 to 11.5°F	(c) None of them	(d) both of them
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What is the main cause of global sea level rise?

(a) Melting of ice	(b) Rise in temperature	(c) None of them	(d) both of them
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The main effect of sea level rise is/are

(a) Disappearance of low lying countries like Maldives	(b) Occurrence of floods, hurricanes, typhoons, storms	(c) Loss of endemic species and their habitats	(d) All of above
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Every species has its own optimal habitat and tolerance ranges of temperate?

(a) True	(b) False
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Because of sea level rise and increase in temperature,

(a) Species and habitats become endangered and rare	(b) New species are emerged
(c) Species adapt or move to the cooler places	(d) All of above
(e) None of Above	

Impacts of sea level rise and increase in temperature is more in

(a) Marine ecosystem	(b) Terrestrial ecosystems	(c) None of them	(d) both of them
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Atmospheric CO<sub>2</sub> is absorbed by

(a) Plants	(b) Animals	(c) None of them	(d) both of them
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Atmospheric CO<sub>2</sub> is absorbed through the process of

(a) Photosynthesis	(b) Sequestration	(c) Fixation	(d) all of above	(e) None
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Is it true or false that some places are getting warmer and some places are getting colder to the increase in temperature and climate change

(a) True	(b) False
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What do we need to do to save our earth?

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