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研究課題名(和文) Pairing Edutainment with Skills will Improve STEM Education Engagement

研究課題名(英文) Pairing Edutainment with Skills will Improve STEM Education Engagement

研究代表者

Robertson Andrew (Robertson, Andrew)

九州大学・工学研究院・准教授

研究者番号：30623607

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研究成果の概要(和文)：このプロジェクトでは、化学の概念について質の高い詳細な説明を提供することを目的として、58本の長編教育用化学ビデオと25本の短編教育用化学ビデオを作成することができました。動画は非常に人気があり、長編動画のトップ2本はそれぞれ32万回以上、短編動画のトップは260万回以上、チャンネル全体では1100万回以上の再生回数を記録している。このプロジェクトはJUCST2024化学コミュニケーション賞(化学情報協会)を受賞している、国籍、年齢、性別、リテンション(動画の視聴率)、エンゲージメントなど、単純な視聴者数だけではない、クロスオーバーな統計データを数多く生み出している。

研究成果の学術的意義や社会的意義

The videos were published to a multi-lingual, global audience, free of charge, by means of the YouTube video sharing platform. This project has reached tens of thousands of students from all over the world, including countries from the lowest levels of the Human Development Index.

研究成果の概要(英文)：This project enabled the creation of 58 long form educational chemistry videos and 25 short form educational chemistry videos with the intention of providing high quality, in-depth explanations of chemistry concepts. The videos have proven to be extraordinarily popular, with the 2 top long-form videos achieving over 320,000 views each, the top short video achieving over 2,600,000 views, and the channel as a whole receiving over 11,000,000 views in total so far. This project won the JUCST 2024 Chemistry Communication Prize 化学コミュニケーション賞受賞(化学情報協会) The research has generated a great deal of cross-over statistical data beyond simple viewer numbers such as nationality, age, sex, retention (percentage of a video viewed), and engagement.

研究分野：Science Education

キーワード：Chemistry education videos global animation international youtube

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1. 研究開始当初の背景

This was commenced following an observation that educational materials on YouTube could be distributed as either being academic, skills-based materials, or popular, edutainment materials.

Since edutainment content was vastly more popular in terms of views, subscriptions and comments, it appeared to be valuable, therefore, to investigate whether pairing the more popular edutainment materials with the less popular academic skills materials could produce an enhancement of engagement with academic skills videos.

2. 研究の目的

The primary objective was to create videos in pairs, with one edutainment video produced with the purpose of drawing attention to a concept and a second academic skills video, produced with the purpose of enhancing cognitive development for a defined skill set. The paired videos would then be compared with a set of previous videos, already produced, that had been prepared no such pairing methodology.

As a secondary objective, a number of chemistry-based, educational videos would be produced, available to a global audience for free on the YouTube platform. Attention would be paid to enhancing engagement with the two forms of material, with the purpose of discerning the optimal employment of writing, graphics, animations, and sound. All of these factors could be analysed according to demographic attributes such as age, sex, nationality, and home-country rating on the Human Development Index.¹

As a tertiary objective, the employment of the same materials utilising the services of a foreign language presenter and production team would be investigated, to see how the same materials with a local representative would affect engagement and pedagogical attainments.

3. 研究の方法

The research was initiated by producing video materials, beginning with simple topics, and steadily advancing in terms of complexity of concepts and ambition in terms of production values. Uploading materials to YouTube and making them publicly available has many advantages from the point of view of acquiring a wide range of anonymised viewer engagement, demographic, and video performance data. It also enables the recruitment of a cohort of voluntary participants in the order of hundreds to hundreds of thousands of participants.

Following the upload of each video, the viewer engagement performance, in terms of number of views, and average percentage viewed, was recorded. Changes in subscriber numbers allowed an assessment of expected future interest in the materials, which is an important gauge of the interest of the subjects in the corpus of the materials as a whole. The performance of a video, or video pair, was then compared with previous materials, and used to plan further video production to discover what elements of these educational videos connected optimally with the global audience.

For the international language videos, translators, presenters and editors were recruited to produce videos in their native languages, in this case Persian and Indonesian. The scripts, graphics, and animations were common with the English language materials, with the intention to allow a direct comparison with the already-available English language materials.

4. 研究成果

Overview


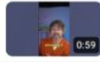




Short	Date	Views ↓
 Where is all the oxygen? Most people don't realize where all the oxygen is. Do you know? 0:41	May 30, 2024 Uploaded	2,670,475
 Beryllium - the Most Disappointing EL. If you want to hear the great things about beryllium and the chemistry of beryllium... 0:59	Nov 2, 2023 Uploaded	2,208,916
 2nd Row Rules! #chemistry #periodict... Visit us on Instagram: https://www.instagram.com/sannijuroku... 1:00	Sep 29, 2023 Uploaded	1,097,789
 How did helium make the first ever m... Visit us on Instagram: https://www.instagram.com/sannijuroku... 1:00	Sep 22, 2023 Uploaded	672,368
 Nitrogen is... ironic. #chemistry #nitro... Unfortunately, I had to cut out the part that goes 'What makes things worse is...' 1:00	Jan 12, 2024 Uploaded	568,670
 Do positive hydrogen ions actually exi... Visit us on Instagram: https://www.instagram.com/sannijuroku... 0:58	Sep 8, 2023 Uploaded	532,811

Figure 1 – Top performing videos

the top Short video achieving over two million, six hundred thousand views (*Figure 1*), and the channel as a whole receiving over eleven million views in total so far (*Figure 2*). This project has reached students from all over the world, including countries from the lowest levels

Views ↓ ▲	Watch time (hours)	Subscribers
11,018,904	293,292.2	92,231

Figure 2 – Total viewer engagement

of the Human Development Index. This project won the JUCST 2024 Chemistry Communication Prize 化学コミュニケーション賞受賞 (化学情報協会) .³

After a year of development, it was found that, though the central of whether edutainment videos could generate interest in long form academic skills videos could well be valid, the YouTube algorithm used for choosing videos to serve potential viewers would not permit a proper crossover between edutainment and educational videos. The research has generated a great deal of cross-over statistical data beyond simple viewer numbers such as nationality, age, sex, retention (percentage of a video viewed), and engagement, as detailed below.

Phase I – Investigation of principal question

The initial phase of the work involved creating videos on related topics but with a different emphasis on edutainment, core concepts, and skills (*Figure 3*). Initial videos covered concepts on making presentations, the octet rule, and moles. Furthermore, a collaboration with Ansford Academy school in Castle Cary, UK resulted in five videos




 Questions and Answers 1 (part 3) 35:42	
 Hit me with your questions! (Part 2) 'Hit Me with Your Questions 1 (Part 2)' is here with my answers to your questions... 22:10	
 Hit Me with Your Questions! (Part 1) 'Hit Me with Your Questions 1 (Part 1)' is here with my answers to your questions... 38:26	

Figure 3 – Collaboration with UK school.

This project enabled the creation of fifty eight long form educational chemistry videos and twenty five short form educational chemistry videos providing high quality, in-depth explanations of chemistry concepts. The videos were published to a multi-lingual, global audience, free of charge, by means of the YouTube video sharing platform.² The videos have proven to be extraordinarily popular, with the two top long-form videos achieving over three hundred and twenty thousand views each,




 Complete History of the Avogadro Nu... How did the Avogadro number happen? How did he know about molecules before... 34:55	
 Avogadro Number outtakes I thought I'd make a quick walkie-talkie video on how the Avogadro number cam... 3:21	
 How and Why Do Chemists Use Moles? What are moles and how do chemists use them? Why do chemists use moles? We... 26:06	

Figure 4 – Moles Concept, edutainment, skills.

specifically aimed at 14 year-old students taking early science courses (*Figure 4*). However, after a period of about a year, it became clear that, although the central concept of connecting edutainment videos to academic skills videos might be effective, it is counterproductive on the YouTube platform and probably on any social media platform. This is a result of the algorithm making a quick and superficial assessment of whether videos should be shown to a wider audience. In other words, YouTube will not share videos

from the same channel that primarily appeal to different kinds of viewers (*Figure 5*). It was expected that all social media platforms would have similar shortcomings, and given a considerable lack of interest from peer-reviewed education journals to publish accounts based on social media methodology, it was decided to adapt the question towards how best to optimise chemistry education videos for maximum public engagement and social education benefit.

Phase II – Optimising parameters for social engagement with chemistry concepts

Optimising the parameters of the videos for better social engagement with chemistry concepts meant choosing a single central vision. At this stage, videos were written and produced to focus only on chemistry concepts. Furthermore, the concept of the target audience was refined to encompass ‘those with a knowledge of, or an interest in, chemistry’. These changes resulted in a dramatic uptake by the YouTube algorithm, which caused a positive feedback in viewer engagement, which led to a significant increase in reach across a wide range of demographics (*Figure 5*).

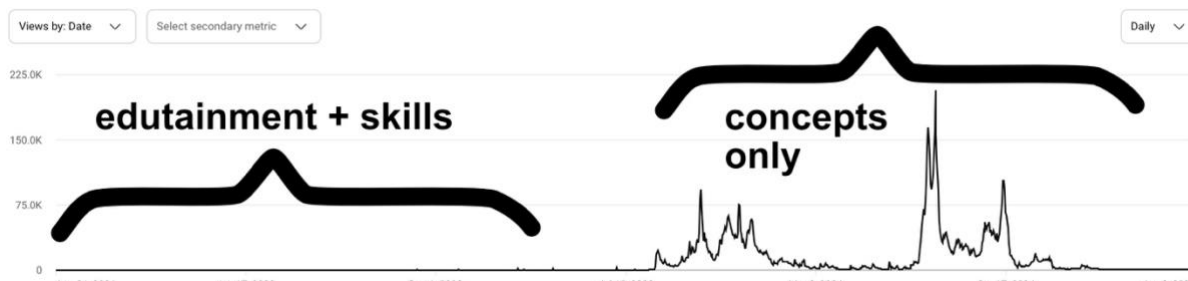


Figure 5 – YouTube won't promote channels with split focus.

At this point, a popular series of short videos (known as YouTube Shorts), highlighting little-known aspects of the chemical elements, demonstrated a validation of the initial concept of using edutainment to generate interest in deeper chemistry concepts. This series proved very popular, with the two most popular videos (beryllium and oxygen) each gaining well over 2,000,000 views each (*Figure 6*).

Short	Date	Views ↓
<p>Where IS all the oxygen? Most people don't realise where all the oxygen is. Do you know?</p>	May 30, 2024 Uploaded	2,670,475
<p>Beryllium – the Most Disappointing El... If you want to hear the great things about beryllium and the chemistry of beryllium,...</p>	Nov 2, 2023 Uploaded	2,208,916

Figure 6 – Two videos with over 2,000,000 views

Social contribution

The channel has so far gained over 11,000,000 views from 180 countries around the world. Many of these countries score at the lowest levels of the Human Development Index, including the Democratic Republic of Congo, Pakistan, and Liberia.¹ India ranks second as the most engaged country with over 2,000,000 views.

The channel is popular with viewers of all ages, with the general trend similar to a reported general trend for YouTube viewers, though with a bias towards viewers of university age (*Figure 7*).⁴

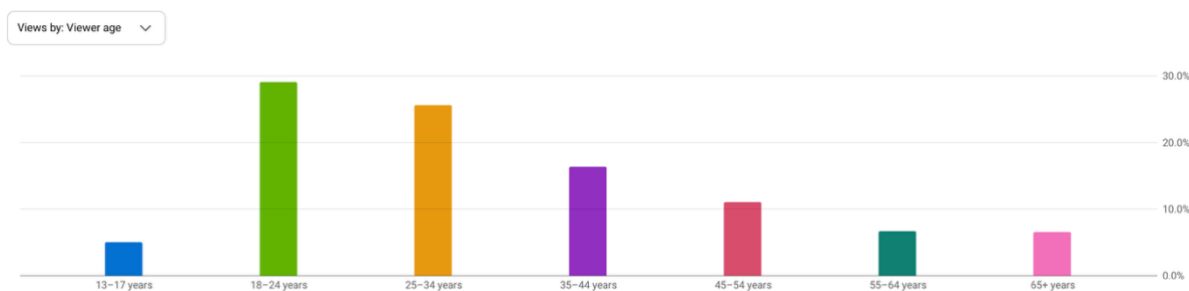


Figure 7 – Age distribution of viewers.

Outreach

The success of the channel generated much interest in the community, leading to the following public outreach activities:

2023.5.24 Brown Bag Seminar #96: The Pros and Cons and More Cons of Teaching on YouTube.⁵

2023.11.18 Nerd Nite#11 public symposium: Successful YouTube Channels – what’s going on behind the scenes?⁶

2024.10.22 6th Japan SciCom Forum Conference Workshop – Getting Started with Videos – From Equipment to Editing.⁷

2025.2.10 The ScienDist: Career Thoughts Over Coffee, podcast interview: Chemistry and YouTube.⁸

Final conclusions

The YouTube platform has many useful features for improving engagement with chemistry education for a global audience. However, the demanding and time-intensive nature of the video sharing algorithm means significant and continuing expense in terms of video production is required for an optimum public outreach outcome. This means that, while YouTube may be an appropriate medium for small audiences, or large audiences for a very few educators, it is not practical for most.

References and links

¹ Human Development Index <https://hdr.undp.org/>

² Three Twentysix: https://youtube.com/c/three_twentysix

³ JUCST prize: <https://www.jaici.or.jp/news/info/2025/2025-2-25/>

⁴ YouTube overall age demographic: https://www.globalmediainsight.com/blog/youtube-users-statistics/#YouTube_Age_Demographics

⁵ Brown bag seminar: <https://sdgs.kyushu-u.ac.jp/en/9362>

⁶ Nerd Nite #11 <https://kyushu.nerdnite.com/2023/10/30/nerd-nite-kyushu-11/>

⁷ JSF <https://www.japansci.com/conference/jsf24>

⁸ The ScienDist: <https://youtu.be/l8EmgR1P7ss?si=34mL9tjPOoDnitSk>

5. 主な発表論文等

〔雑誌論文〕 計0件

〔学会発表〕 計0件

〔図書〕 計0件

〔産業財産権〕

〔その他〕

List of public videos: The Chemistry of Fire https://youtu.be/i_tkAh-wnxU; The Chemistry of Crystals <https://youtu.be/oreVnyqHslc>; Is nuclear power good or bad? <https://youtu.be/yT1-s0nihg4>; What is a Unit Cell? <https://youtu.be/T-X6-xwzv1A>; Static electricity is more complicated than you think <https://youtu.be/m7Sww1FwsPI>; The Chemistry of Moisturisers <https://youtu.be/bSJNAQzxQDA>; I TRIPLED the effects of my caffeine! <https://youtu.be/V5iz19Jg3ho>; What IS the hydrogen economy? <https://youtu.be/NaZ-xiq7EhY>; How does evaporation REALLY work? <https://youtu.be/Ybs4yLrVcvU>; Boiling is more complex than you think! <https://youtu.be/RIBsG1ANcCo>; What ARE atomic orbitals? <https://youtu.be/23bNw4G9DZk>; How atoms REALLY make molecules! <https://youtu.be/oWzuqLl6lto>; How Do Chemical Reactions REALLY Happen? <https://youtu.be/omqDvkEcZmQ>; What IS activation energy, really? <https://youtu.be/A-moXH8r7Ig>; How DO Molecules Store Energy? <https://youtu.be/5fzc3wgAKks>; Complete History of the Avogadro Number <https://youtu.be/SRiNc1AA8vg>; Where IS all the oxygen? <https://youtube.com/shorts/qxCAWD7PMzs>; Beryllium – the Most Disappointing Element <https://youtube.com/shorts/MSIBUvugmFA>; 2nd Row Rules!; How did helium make the first ever molecule? <https://youtube.com/shorts/TuxJgQtC6WQ>; Nitrogen is... ironic. <https://youtube.com/shorts/2jmk02EoYZU>; Do positive hydrogen ions actually exist? <https://youtube.com/shorts/TrEoXKjBlyc>; Do negative hydrogen ions exist? <https://youtube.com/shorts/irrZ7fW04Dg>; O=O is WRONG! <https://youtube.com/shorts/CcCqkJ5yXsU>; Why is nitrogen so stable? <https://youtube.com/shorts/Dfk1g1rgxH8>; Why do Electronic Orbitals Look Like Clouds? <https://youtube.com/shorts/OEW9ldmM6iw>; Why boron for slime? <https://www.instagram.com/sannijuroku/>; Why is lithium used in rechargeable batteries?; Why is carbon the best element? https://youtube.com/shorts/-qCVd6F_m38; What evaporation effect do even chemists get wrong? <https://youtube.com/shorts/Zbzf8RiHqPM>

6. 研究組織

氏名 (ローマ字氏名) (研究者番号)	所属研究機関・部局・職 (機関番号)	備考

7. 科研費を使用して開催した国際研究会

〔国際研究会〕 計0件

8. 本研究に関連して実施した国際共同研究の実施状況

共同研究相手国	相手方研究機関