

## DIGITAL CARICATURE DRAWING ENHANCES STUDENTS' UNDERSTANDING IN LEARNING ABOUT CHROMOSOME

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### **Abstract**

Humans have 24 different types of chromosomes and each chromosome can be identified by its unique characteristics. In a cytogenetics laboratory, analyzing chromosomal characteristics is crucial because it is performed on real patient samples, allowing diseases to be diagnosed directly. However, identification of these chromosomes is difficult to perform for novices in this field, particularly biomedical science students. Drawing is one of the teaching and learning tools that has been shown to improve memory, information processing, cognitive process, and comprehension. The drawing approach is incorporated into the Cytogenetics subject due to these advantages. The students were given an Easy ID Chromosome Caricature e-Book, which contains a collection of human chromosomes with unique characteristics being highlighted and they must use a graphical software to transform the chromosomes into caricatures. Their feedback was gathered before and after the intervention was carried out. There were noticeable improvements in the students' understanding of the chromosomes' characteristics, ability to identify and differentiate the chromosomes based on their respective numbers and acquisition of relevant soft skills. Chromosome caricatures require high imagination and drawing skills, which could be used as alternative teaching and learning tools in Cytogenetics. The favorable feedback received encourages the strategy to be implemented in the subsequent cohorts of students.

*Keywords:* cytogenetics; electronic book; graphic drawing; chromosome; university student

### **Abstrak**

Manusia mempunyai 24 jenis kromosom berbeza dan setiap kromosom boleh dibezakan dengan ciri-ciri istimewa. Di makmal sitogenetik, analisis makmal melibatkan ciri-ciri istimewa kromosom amat penting kerana ia dijalankan pada sampel sebenar pesakit yang membolehkan sesuatu penyakit didiagnos. Walau bagaimanapun, pengenalan kromosom ini sukar dijalankan kepada mereka yang baru menceburi bidang ini terutamanya pelajar sains bioperubatan. Salah satu pendekatan pengajaran dan pembelajaran adalah dengan melukis dan pendekatan ini telah menunjukkan kesan yang baik seperti merangsang memori, pemprosesan maklumat, pemprosesan pemikiran dan menambah pemahaman. Dengan itu, pendekatan melukis diaplikasikan dalam subjek Sitogenetik. Dalam pendekatan ini, pelajar diberikan Easy ID Chromosome Caricature e-book yang mengandungi koleksi ciri-ciri kromosom manusia secara kasual dan pelajar dikehendaki melukis karikatur kromosom dengan menggunakan perisian grafik. Maklumbalas sebelum dan selepas intervensi dikumpulkan. Terdapat peningkatan kefahaman pelajar terhadap mengenalpasti ciri-ciri kromosom, kebolehan mengenalpasti dan membezakan nombor kromosom serta kemahiran insaniah. Penghasilan karikatur kromosom memerlukan imaginasi dan kemahiran melukis yang tinggi yang boleh digunakan sebagai alternatif pengajaran dan pembelajaran. Maklumbalas baik yang diterima menunjukkan pendekatan ini boleh digunakan pada pelajar kohort akan datang.

*Kata kunci:* buku elektronik; kromosom; lukisan grafik; pelajar university; sitogenetik

### **1.0 INTRODUCTION**

Teaching science is a challenging task as it involves complex comprehension and higher order thinking skills. Various teaching and learning methods, such as visual presentation via sketching or drawing, have been used to aid students' understanding. Drawing integrates multiple skills such as thinking, organizing, integrating information and developing memory (Heideman et al., 2017). This approach is known to be a powerful tool, as it can simplify complex information and make it clear and visible to learners (Quillin & Thomas, 2015). As this is a promising approach, the next challenge is to develop an intervention tool that is focused on a specific module so that students can successfully implement this in the future.

Drawing activities are frequently incorporated into art classes, particularly in schools. Previously, caricature drawing has been implemented in science subject to primary school students and they demonstrated improved scientific acquisition (Al-Araimi et al., 2018).

Meanwhile, cartoon concept was applied as teaching approach in science education of primary school students in Malaysia (Norfarah et al., 2019). However, university students, particularly those in the sciences, rarely have the opportunity to use this approach in learning, except for those who are visual learners.

Cytogenetics is a branch of biology that studies chromosomal changes in human cells. Before any in-depth analysis can be performed in the diagnosis of genetic diseases, students must grasp the basic knowledge of this course through the identification of normal chromosomes. However, it was discovered that students were having difficulties in identifying and distinguishing the chromosome's according to their numbers. To address this problem, cytogenetic experts and our teaching team collaborated to create a teaching approach that is using a pictures to imitate casual characterization or framework that focuses on the unique parts of each chromosome. Advances in technology have however, led to the development of many graphic design software programs to aid in digital drawing and designing. Because today's students are Gen Z, they are adept at using technology, and this approach may pique their interest in producing the best caricature drawings and could help them in understanding chromosome characteristics better. Thus, the chromosomes with their unique features could be represented by caricatures created by students digitally.

## **2.0 MATERIALS AND METHODS**

A study was carried out to compare the effects of Easy ID Chromosome Caricature before and after it was implemented. This study included 87 final-year students from the Biomedical Science Program, Faculty of Health Sciences, Universiti Kebangsaan Malaysia (UKM), who were enrolled in the Cytology and Cytogenetics subject.

The students were given a briefing on how the teaching and learning process will be conducted at the 1st week starting of the semester. The students were divided into small groups with each group consisted of 4 students. A guidebook known as The Easy ID Chromosome Caricature e-Book was uploaded via the UKM education portal, UKMFolio (<https://ukmfolio.ukm.my>) and the students can access freely this guide prior to designing the caricature as reference. Each group was allocated to one chromosome number and they need to design a caricature according to that particular chromosome number up to their creativity by highlighting important characteristics of that particular chromosome. A presentation was conducted at the end of semester and all students presented their caricature designs as part of teaching and learning activities.

## 2.1 The Easy ID Chromosome Caricature e-Book

The e-book (Figure 1) was divided into three components: i) Ideogram: a formal schematic diagram of a chromosome taken from a chromosome analysis standard reference; ii) Pseudochromosome: a chromosome structure that resembles the real chromosome, labeled with its own distinct characteristics; and iii) Practice space: a blank space to draw the chromosome caricature. Graphic design software programs such as Adobe Photoshop, PowerPoint, ibis Paint X, Canva and Procreate were used to design the caricature.

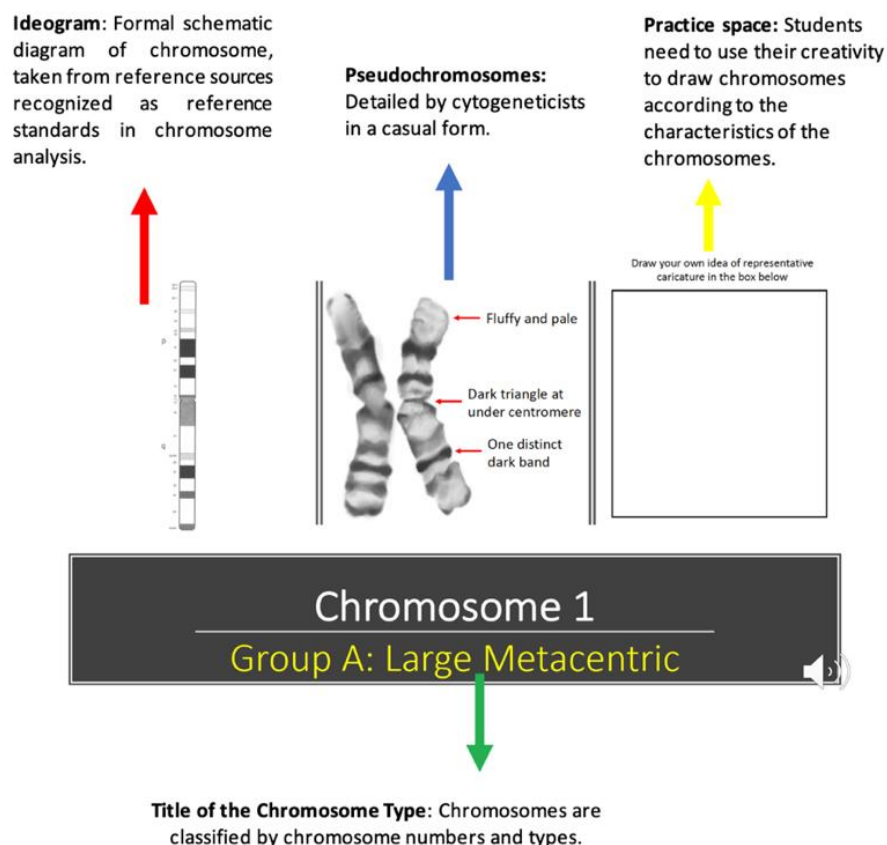


Figure 1: Example of the content in Easy ID Chromosome Caricature E-Book.

## 2.2 Survey

A survey was conducted using Google Forms to evaluate the approach and to collect the feedback before and after the implementation. The questionnaire was divided into two sections: A) Demographic Data and B) General Evaluation. The students were required to select only one of three options: no, maybe or yes.

## 2.3 Data Analysis

Descriptive analysis was used to analyze section A. The frequency of answers was calculated

based on the responses in section B. The information is presented in the form of a graph.

### 3.0 RESULTS AND DISCUSSION

#### 3.1 Demographic Data

A large majority of the students were female (82%), with male students only being 18% of the total number. Their ages ranged from 22 to 30 years old, with the majority of them being 23 (63%). Slightly more than half of the students (52%) received study loans, while the remainder relied on their parents (26%), scholarships (12%), or part-time work (2%) for their monthly allowance.

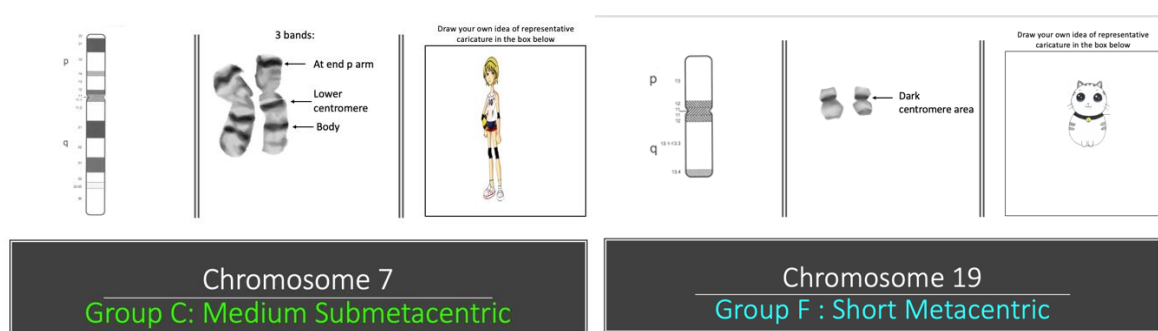
Table 1: *Demographic data of subjects*

Variables		% (n)
Age	22	2% (2)
	23	78% (26)
	24	21% (7)
	25	4% (3)
	28	2% (2)
	30	1%(1)
Gender	Male	18% (16)
	Female	82% (71)
Marital Status	Single	100% (87)
Source of money	Scholarship	12% (10)
	Part time job	2% (2)
	Study loan	60% (52)
	Parent/family	26%(23)

#### 3.2 Caricature Design

Students were required to create caricatures based on the chromosomes in the e-book. The distinct characteristics of the chromosomes were labelled in layman's terms that were endorsed by cytogenetics experts. The layman's terms were used to familiarize students with the chromosome structure, after which they could use their imagination and creativity to create the caricature design (Figure 2). There are numerous graphic design software programs available today that could be used as teaching and learning tools. These tools have appealing features and could assist students in creating the caricatures. Graphic design software such

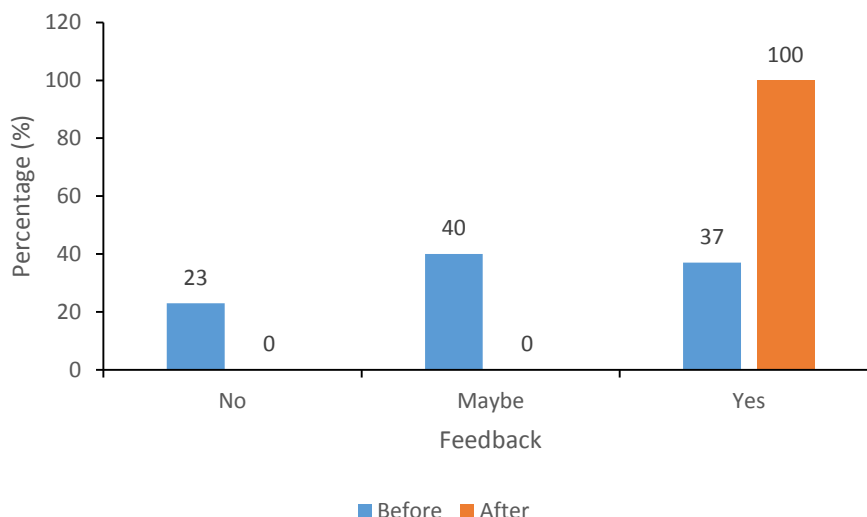
as Adobe Photoshop, Power Point, ibis Paint X, Canva, and Procreate were used to create the caricatures. These software programs can assist in increasing students' participation during the current era of digital learning. Because of the COVID-19 outbreak that begun in 2020 and the resultant lockdowns, most educators were forced to abandon face-to-face teaching methods and have shifted to online methods, using various online approaches such as messaging apps, game-based platforms, and e-learning software that can be customized to suit education purposes (Clavier et al., 2019; Felszeghy et al., 2019; Henderson et al., 2020).



*Figure 2:* Examples of chromosome caricatures (chromosome number 7 and 19) designed by the students using graphic design software.

### 3.3 Students' Understanding of the Basics of Chromosome Identification

The conducted survey obtained the students' perception of their understanding on the individual chromosomes' characteristics. The results showed a positive trend, indicating an increase in the students' understanding of each chromosome's structure (Figure 3). Following that, they were able to distinguish the chromosome types. In the e-book module, the students were instructed to go through the unique characteristics highlighted for each chromosome number and create a caricature that best represented the chromosomes. The resultant caricatures ranged from humans, animals and cartoon characters. This suggests that the arts and sciences may intersect. Moreover, this can serve as a foundation that could potentially be animated in the future to bring the caricatures to life (Lepito, 2018).



*Figure 3:* Feedback on students' understanding of basic chromosome identification for before and after intervention.

### 3.4 Students Ability to Identify the Chromosomes' Characteristics

One factor that could aid in their memorization was the caricature designs that were created. The created caricatures were based on the specific features that were highlighted. In this study, the majority of students agreed that the intervention improved their ability to differentiate and memorize the chromosomes (Figure 4 and Figure 5). Previous research found that drawing could improve students' memory by providing vivid contextual information that can be used for future information retrieval (Wammes et al., 2018). As the visual-sensory brain regions are activated during the process, this approach can incorporate visuoperceptual information into memory-enhanced performance (Meade et al., 2021). The drawing method has been widely used in teaching, particularly among medical and health science students (Chan, 2013; Mathon et al., 2021; Robinson et al., 2018). As a result, educators must plan the appropriate module to suit the learning outcomes of the subjects.

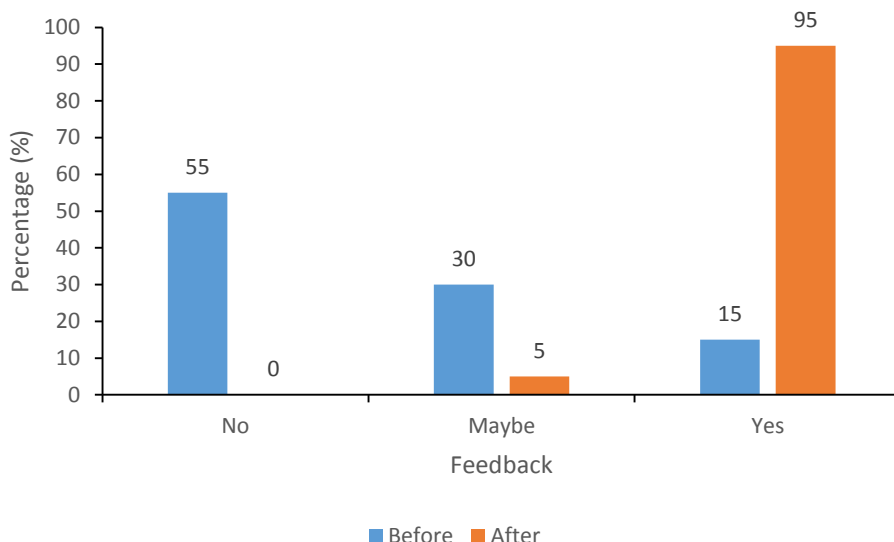


Figure 4: Feedback on students' opinion in their ability to differentiate the chromosomes before and after intervention.

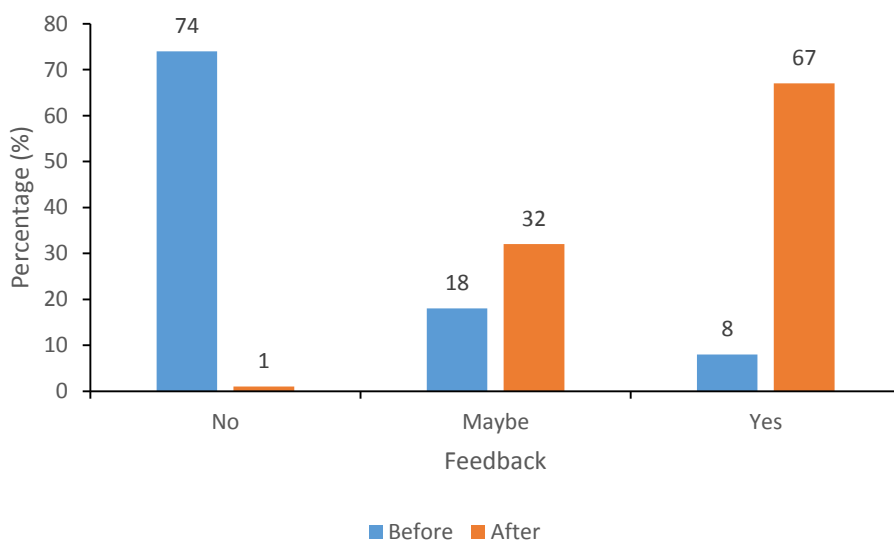


Figure 5: Feedback on students' opinion on ability to remember the chromosome characteristics.

### 3.5 Soft Skills Developed

In addition, the students agreed that they had learned valuable soft skills. This innovation was found to improve students' creativity, critical thinking, teamwork, and graphic design skills through the use of art tools (Figure 6). Taken as a whole, the approach yielded positive outcomes, even if it was executed online.



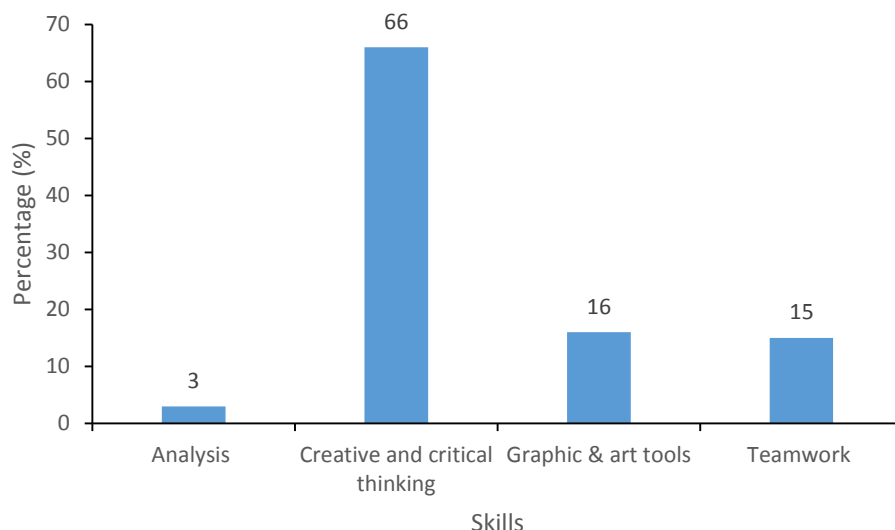


Figure 6: Feedback on the soft skills that the students developed after the intervention.

#### 4.0 CONCLUSION

The caricature drawing approach to chromosome representation as implemented in the Easy ID Chromosome Caricature e-Book could serve as an alternative teaching tool in Cytogenetics. The module benefits students by improving their understanding and ability to identify chromosomes, while at the same time instilling valuable soft skills. This approach has the potential to be adapted to suit other relevant teaching subjects in the future.

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