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Famillelle: Genetic Inheritance Card Game

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ABSTRACT

Genetic discoveries have become powerful tools in improving quality of life. The knowledge about gene allows us to explore details of all living organism at molecular level. Such understanding leads to enormous potential in various aspects of human life. In secondary school, students are required to learn heredity and variation in science and biology subject. They are introduced to various terminologies such as gene, allele, genotype, phenotype, homozygous, heterozygous and others. Some students even struggling to relate the meiosis process with genetic inheritance. As temporary solution for this problem, students tends to memorize all terminology without understanding the whole concept. Famillelle is a combination of family and allele which describing the game clearly. This game requires basic understanding of selective human characteristics using Mendelian monohybrid inheritance. In this game, three type of cards will be distributed to every player. They are mission card, family card and blank card. A total of 40 cards will be distributed evenly among all players. A set of famillelle has 5 cards consisting of father, mother and 3 baby cards. Each mission card is describing a family with missing members. The players are required to reunite all the famillelle member. The first player to complete a set of famillelle wins the game!

Keywords: Mendel; allele; monohybrid & genetic

1. INTRODUCTION

Genetic deals with heredity and variation. It allows us to understand existence of life at all level of complexity from molecular to population level. Genetic inheritance involves discrete heritable units passed on by parents to their offspring. It is sometimes reappeared after skipped generation. Heritable feature is called character with variant for the character is a trait. In Simple Mendelian inheritance, trait can be affected by genes with two different alleles at one time where one is dominant than the other. The term simple Mendelian inheritance obey two laws: the law of segregation and the law of independent assortment.

Law of segregation states that the two alleles separate from one another during gamete formation and end up in different gametes. Law of independent assortment on the other hand states that two or more genes that alleles located on different homologous chromosome assort independently of other pair during gamete formation [1].

Genetic discoveries have become powerful tools in improving quality of life. The knowledge about gene allows us to explore details of all living organism at molecular level. Such understanding leads to enormous potential in various aspects of human life. In agriculture, this knowledge is used to produce better crops with high drought tolerance and better nutritional properties that would benefit farmers worldwide.

In secondary school, students in form 4 and 5 is required to learn heredity and variation in science and biology subject. They are introduced to various terminologies such as gene, allele, genotype, phenotype, homozygous, heterozygous and others. They must be able to identify dominant and recessive allele in human, as well as illustrate inheritance pattern using genetic diagram with expected genotype and phenotype ratio [2,3].

Many educators feel that teaching complex concepts and vocabulary in genetics inheritance usually discourage many students. These challenges could probably due to unseen processes since it involves genes on chromosome. Some students even struggling to relate the meiosis process with genetic inheritance. As temporary solution for this problem, students tends to memorize all terminology without understanding the whole concept. Effectively, educators should devote more effort to help students to independently learn and solve problems [4].

Consequently, this card game is developed focusing on heredity using human characteristics. Card game showed to be more effective in understanding topics in biology compared to traditional teaching method [5]. Apart from that, individuals can learn more within a group than when they are alone [6]. Several traits carefully choose to be used in Famillelle: genetic inheritance card game. They are earlobe pattern, existence of Widow's peak and blood group. Both earlobe pattern and existence of Widow's peak obey simple Mendelian inheritance. Free earlobes and Widow's peak are dominant to attached earlobe and no Widow's peak. Blood group display multiple allele as well as codominance. Blood group A and B is codominance while O is recessive.

2. INNOVATION DEVELOPMENT

An observation was made in form 4 classes during learning heredity and variation. It is observable that explaining to students are very excruciating to most teachers. Hence, arranging classroom activities becomes more challenging. For this reason, Famillelle genetic inheritance card game is developed to help teachers in conducting classroom activities that are inexpensive, fun and enlightening.

Famillelle

Educational card game: Famillelle uses three selected human characteristics (Ear lobe, Widow's peak and blood group) with dominant and recessive characteristics stated, students need to reunite the Famillelle based on the description given. This game requires basic understanding of Mendelian monohybrid inheritance where each allele is segregated in one gamete at the end of meiosis. Famillelle is develop in two languages; English and Malay to fit in Malaysia's education environment depending on selected

language used in teaching science subject in school. In this game, there are three type of cards which are mission card, family card (father, mother & baby) and blank card. A total of 40 cards will be distributed evenly among the players. A set of Famillelle has 5 cards consist of father, mother a 3 baby cards. Each mission card is describing a family with missing members. Mission card have two level of difficulties (beginner and expert). This will allow more excitement in problems solving for different students' need. The players are required to reunite all family members based on the clues written in the mission card. However, players need to aware of the genotype and phenotype of all the family members. Makes sure they are correct! The first one to complete a set of Famillelle wins the game!

A set of the Famillelle cards consist of the followings:

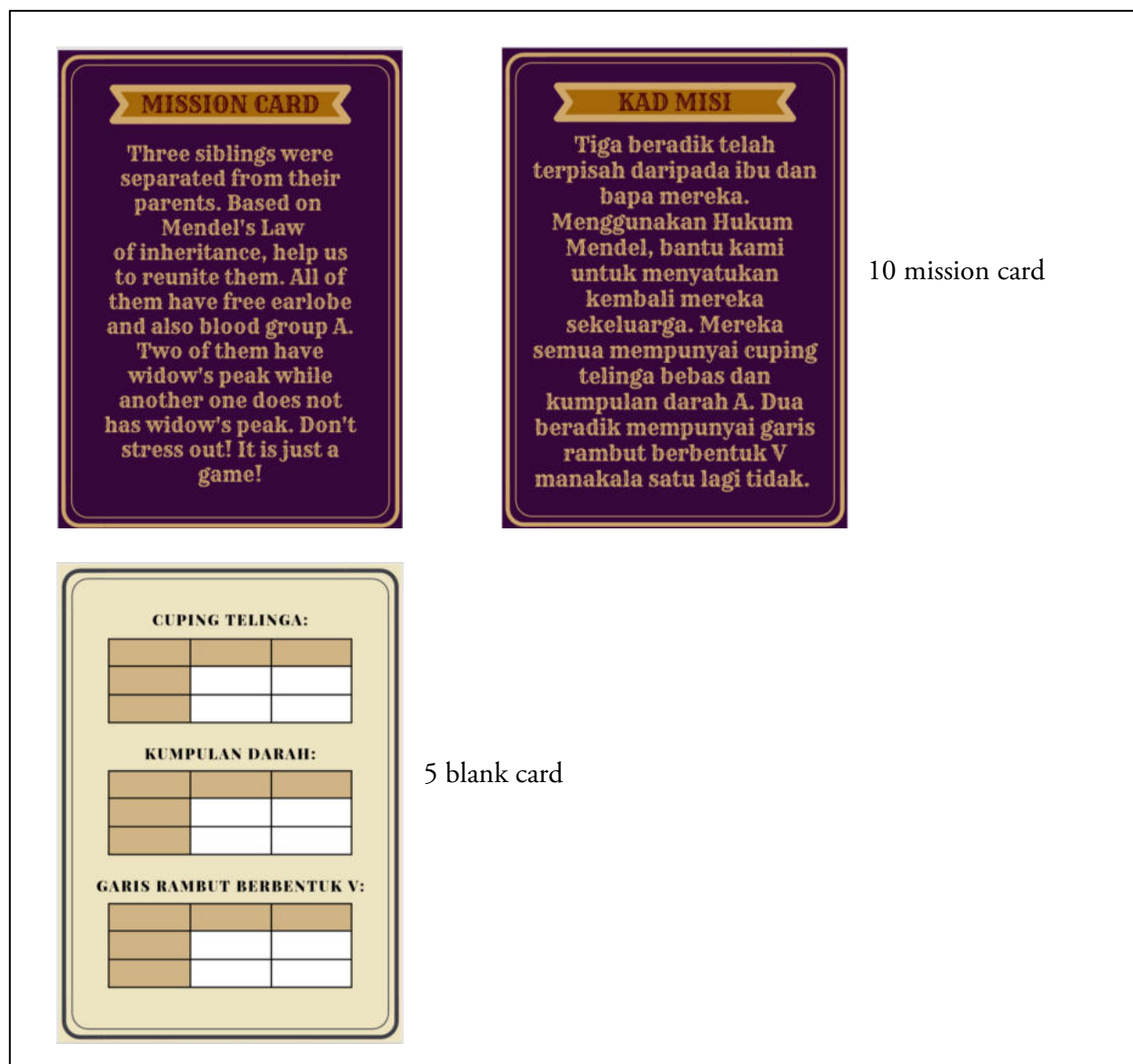


Figure 1: Total number of mission and blank card included in a set of Famillelle



Figure 2: Total number of family card comprises of father's, mother's and baby's card included in a set of Famillelle

Learning Outcome

Our aim for this game activity is to convey the followings learning outcome. After playing this game, students can:

- Differentiate between homozygous and heterozygous [2,3]
- Draw a correct punnet square [3]
- Identify dominant and recessive characteristic in human [2,3]
- Illustrate inheritance using genetic diagram [2,3]
- Predicting genotype and phenotype ratio [2,3]

Warm Up Questions

Prior to beginning of the game, we encourage teachers to divide students into groups randomly. Next, set of warm up questions asked to students as reflections upon their understanding of heredity and variation. They will have a bit of struggle and probably need to discuss in the group to find the answer. However, they will have the key concepts as they begin playing. They need to be introduced to three (3) traits used in this game as follows:



Figure 3: Three human traits used in Famillelle with degree of dominance respectively

Then, students need to write down genotype and phenotype of heterozygous and homozygous individual of one desired trait. Give some time for students to think and discussed in the group. Until everyone gets the right answer. Next, ask them to draw a genetic diagram to illustrate a cross between two individuals written before including phenotype and genotype ratio.

Set Up

All family card is distributed to all player with one mission card and one blank card.

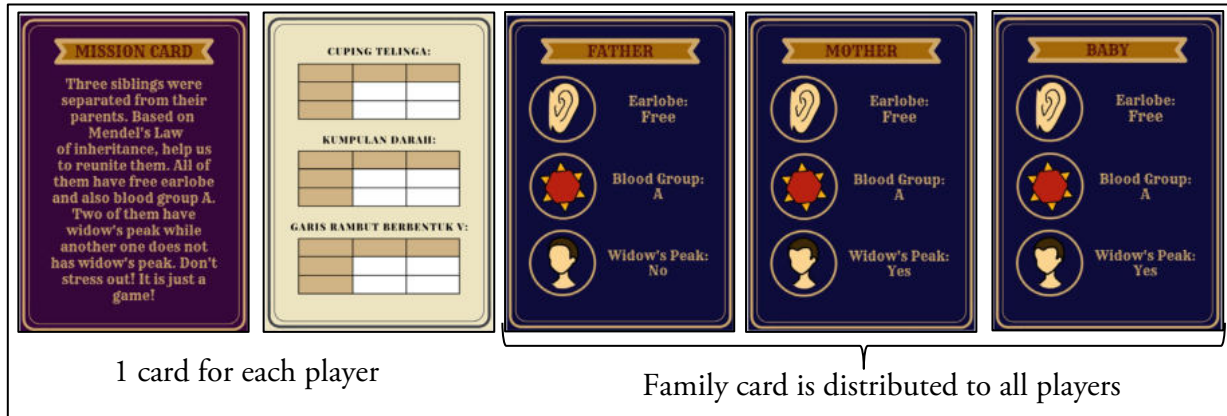


Figure 4: Schematic set up of Famillelle

Playing and winning

1. Read clues given in the mission card. Keep all family card that might match the Famillelle described in mission card.
2. Every player needs to pass the unwanted card to the next player beside them in the desired direction.
3. Take some time to think, cards accepted by other player might match the Famillelle described in mission card.
4. Keep on passing card until one of the players found a complete Famillelle.
5. Check the cards together. Match both parents' genotype with all baby's card. If all cards are correct, the player wins!
6. Distribute all winner's card to other players until everyone find their Famillelle!

Figure 5: Instruction to play Famillelle until one winner is recognized

3. COMMERCIAL POTENTIAL

Famillelle provides fun, low-cost, and educative classroom activity. It includes two level of difficulties to fit in two different background of target students; science students form 4 and biology students form 5. Other than that, it is develop in two languages to suit different language used at various schools or institutions. A preliminary was conducted in a tuition centre with form 5 science students. The session has turned into a very interesting revision for them since genetic inheritance was taught during form 4. All students give very supportive feedback and would suggest using Famillelle as classroom activity. Undeniably, Famillelle can provide effective learning strategy and suitable for schools (government, international etc), pre-university institution, or even tuition centre.

4. CONCLUSION

Various study in teaching biology or general science highlight the effectiveness of hands-on activities with student engagement in learning process [7,8]. We have described a guideline in using Famillelle to encourage students to interact in a small group and challenge each other to win. A test should be conducted to evaluate students' performance using Famillelle compared to traditional method.

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