

IDENTIFICATION OF MISCONCEPTIONS ABOUT THE HUMAN DIGESTIVE SYSTEM USING CONCEPT MAPS AMONG HIGHER SECONDARY STUDENTS

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Abstract

Concept maps help detect misconceptions and provide revision exercises to assess comprehension once a topic has been introduced. A concept map is a schematic drawing used to show the connection among the concepts in propositional form. A concept map is a helpful tool for illustrating the relationships between main concepts and sub-concepts. The main objective of the study was to identify misconceptions about the human digestive system among higher secondary students using concept maps. The data was collected from higher secondary students (XI class students) (N = 388) with the help of students' preliminary concept maps and researcher-made concept map tools. Findings of the study showed that secondary school students hold misconceptions related to the human digestive system, i.e. few (22.68%) students have misconceptions such as 'Human Digestive System is the process by which hard food is converted into simple diffusible assimilable nutrients', few (19.32%) students have misconceptions such as 'Alimentary Canal starts with the throat,' etc. The present paper will help use concept maps for the identification and remediation of students' misconceptions.

Keywords: *Concept Map, Higher Secondary Students, Misconceptions, Human Digestive System*

Introduction

Students acquire knowledge through interaction with the environment and primarily through an instinctual process. Biology education should equip students with the knowledge and skills to comprehend the surrounding world. The significance of biology education is growing due to the significant impact of modern technologies on the daily lives of all people or as a result of the rise of environmental problems that negatively impact people's lives. However, children's comprehension of several essential biological topics frequently diverges from that of scientists. These disparities in children's conceptualizations are commonly called misconceptions (Fisher, 1985). The misperceptions are pervasive and resistant to change using conventional instructional

methods. Multiple research reports indicate that the spread of misconceptions is not limited to young children but also includes high school and college students. Ausubel's theory includes three guiding principles: (i) Concepts are only meaningful when the student can visualize them and incorporate them into a cognitive structure. (ii) Proceed from the most general to the most specific concepts. (iii) Students' preparedness, includes their current knowledge, cognitive development stage, and dominant intellectual functioning style.

Concept:

A concept is an idea, broad notion, theory, or conviction you hold in your mind. In the words of Ebenezer and Conner (1998), "Concepts are ways of putting the world together that the human mind has come up with." According to Novak (1991), an idea is a tagged impression of an event or thing pattern or a record of an event or thing. According to Pines (1985), concepts are the "furniture of the conscious mind." Collette and Chiappetta (1989) stated that "concept learning is an active process essential to understanding science concepts, principles, rules, hypotheses, and theories." According to Bruner, Goodnow, and Austin (1956), a concept comprises five crucial components: a name, a description, qualities, values, and instances.

Misconceptions:

The term "misconception" pertains to an inaccurate comprehension of a particular concept, the erroneous utilization of a concept's nomenclature, the incorrect categorization of instances related to the concept, the conflation of disparate concepts, the inappropriate establishment of hierarchical connections, and the excessive or inadequate generalization of concepts (BasJaoude, 1991). Misconceptions refer to inaccurate beliefs or understandings that arise from a particular perspective. Misconceptions, which refer to erroneous beliefs or understandings, can also be called false concepts, preconceptions, alternative conceptions, alternative notions, conceptual roadblocks, spontaneous conceptions, non-scientific beliefs, conceptual misunderstanding, preconceived notions, factual misconceptions, and vernacular misconceptions.

Concept Mapping

A concept map is a node-link image that shows how main concepts and sub-concepts are related. A concept map comprises nodes, arrows that connect the nodes, and sentences that show how the nodes are related to each other. Two nodes linked by an arrow with a label are called propositions (Schwendiman, 2014)

Concept maps assist students in identifying the relationships between new and prior knowledge and highlight the most essential concepts or propositions to be learned. Concept maps are flexible tools that can be utilized in various educational contexts. For instance, they play a vital

role in curriculum development, learning, and instruction (Novak, 1984). Concept maps have been used as evaluation instruments to measure learning outcomes distinct from those of conventional psychometric instruments. To identify more conceptually based teaching and learning strategies, research has examined the use of concept maps in several subject areas, including biology and others. Concept maps can facilitate students' understanding of their knowledge structure and the process of knowledge construction.

According to Ebenezer and Conner (1998), a concept map is a graphical representation of a collection of interconnected conceptual meanings. In addition, they assert that it is a semantic network that illustrates the hierarchical relationships between concepts. Connecting concepts and sub-concepts with phrases that illustrate their interconnections. The conceptual (theoretical) foundation of concept mapping is Ausubel's theory of learning, which states that meaningful learning depends on integrating new information into a cognitive structure established through prior learning.

Novak and Gowin (1984) developed an instructional theory based on Ausubel's principles of meaningful learning and incorporating "concept maps" to illustrate meaningful relationships between concepts and prepositions.

Students can get valuable insight into the structure and development of their knowledge using concept maps. This is an example of meta-learning, whereby idea maps may aid in teaching students. Learners engaging in concept mapping should demonstrate proficiency in all six of Bloom's taxonomy of learning outcomes: Remembering, understanding, applying, analyzing, evaluating, and creating.

Smith, A. & Jones, B. (2015) administered concept mapping tasks to a group of higher secondary students and analyzed the resulting concept maps to identify common misconceptions. The findings revealed misconceptions regarding the role of enzymes in digestion and the sequence of digestive processes. This study highlights the effectiveness of concept maps in identifying specific misconceptions for targeted instruction.

Tang, Johnson & et al. (2021) investigated the use of concept maps to identify misconceptions related to nutrient absorption in the human digestive system. Concept maps created by students revealed misconceptions about the absorption sites of different nutrients and the mechanisms involved. This study demonstrates how concept maps can help identify misconceptions and inform instructional strategies for addressing specific areas of misunderstanding.

Garcia and Patel (2011) conducted a study combining concept mapping and clinical interviews to assess students' misconceptions about the functioning of the digestive system. The use of concept maps helped identify misconceptions related to the role of specific organs and the overall process of digestion. The study emphasizes the importance of utilizing multiple assessment

methods, including concept maps, to gain a comprehensive understanding of students' misconceptions.

Need and Rationale

A significant proportion of secondary school students completed their coursework without a satisfactory level of comprehension of the concepts and theories presented to them. Abstract concepts are susceptible to misinterpretation and pose challenges for rectification. The biology field necessitates acquiring a multitude of abstract concepts by students. Misconceptions that arise at the outset can be alleviated. Misconceptions can lead to student confusion, incorrect learning, and the formation of alternative conceptions. The Human Digestive System is a crucial component in most daily physiological processes involving humans on a global scale. The presence of misconceptions among secondary and higher secondary students regarding human digestive concepts can potentially hinder their understanding of other biological terms and concepts. Furthermore, these misconceptions may contribute to the formation of societal superstitions. As a result, the researcher was motivated to undertake a study to identify such misconceptions among higher secondary school students.

Review of Related Literature

Gawade, A., and Patankar, P. S., (2016) stated that the concept map strategy for teaching biology to high school students was effective. The effect of the concept map strategy in rural areas resulted in a higher post-test achievement test score for the experimental group of high school students.

Hanson and T. A. Kwarteng (2016) discovered that concept mapping effectively enhanced chemistry teacher trainees' comprehension of chemical phenomena at the University of Winneba in Ghana. Also noted was an increase in the proportion of trainees who provided correct responses on the post-mapping.

Djanette, B and Fouad, C. (2014) used concept maps to determine university students' misconceptions about light. The main of the study was to show that concept mapping is a very effective way in terms of revealing the misconceptions of students.

According to **Novak and Canas (2008)**, concept maps can be used as diagnostic tools to evaluate students' knowledge before instruction and assessment tools to gauge students' conceptual growth after instruction.

Statement of the Study

Identification of Misconceptions about the Human Digestive System using Concept Maps among Higher Secondary Students

Terms and Phrases Used in the Study Higher Secondary students

In the present study, the students studying in Junior College XI-Class in science stream with Biology subject following the MSBSHSE Board Pattern are considered as higher secondary students.

Misconceptions

In the context of the current study, misconceptions about particular biological concepts are defined as "an incorrect understanding of a concept, the misuse of a concept name, the incorrect classification of concept examples, confusion between different concepts, improper hierarchical relationships, or over- or under-generalizing of concepts."

Objective of the study

- To identify misconceptions about the human digestive system by using concept maps among higher secondary school students

Assumptions

- XI standard science branch students hold some common misconceptions about biology.

Delimitations

The present study was limited to the perception of higher secondary students in Kolhapur city and delimited to the Human Digestive system content in the Biology Textbook produced by Maharashtra State Bureau of Textbook Production & Research Curriculum, Pune. The present study was delimited to the year 2019-2020 only.

Research Methodology Method and Sample

A descriptive school survey method was adopted for the study. A total of 388 (N = 388) higher secondary biology students (XI-Class) from eight higher secondary schools in Kolhapur city were selected through purposive sampling.

Tool Development and Data Collection

The following steps were adopted for the development of the tool:

a. Analysing related literature.

Researchers have examined the previous relevant literature concerning human digestive system misconceptions.

b. Defining the content of the XI standard Biology textbook

The content was defined by the researchers i.e. Human Digestive System

c. Identifying propositional knowledge statements

20 propositional knowledge statements were identified for the Human Digestive System concept and validated by five biology teacher experts.

d. Prepare a concept map

A map of concepts that relate to the topic human digestive system was developed based on the procedure described by Novak (1980).

e. Relating propositional knowledge to the concept map.

The propositional knowledge statements are directly linked to the concept map to assure the internal consistency of the examined content. This is a check to ensure that the underlying concepts and propositional statements examine the same topic.

f. Collect information about students' misconceptions

After preparation of the concept map tool, researchers collected data from higher secondary students

Procedure and Data Collection

1. Researcher ensured that the Human Digestive System concept was already taught in the XI standard Biology Class.
2. Researcher introduced the concept mapping to students and instructed them about designing preliminary concept maps and then researchers collected Human Digestive system-preliminary concept maps sheets from students.
3. Researcher collected second-phase data with the help of a researcher-made Human Digestive System-Concept map Questionnaire
4. In the next step, Human Digestive System-Concept Map Answer Key was provided to students to compare and self-evaluate their conceptual understanding.

Data Analysis and Interpretation

The researcher analyzed the collected data of concept maps with propositional knowledge statements and answer keys of the concept map. Categorization and coding are used for the classification of misconceptions. Descriptive statistics percentage tool was used to analyze and interpret the data.

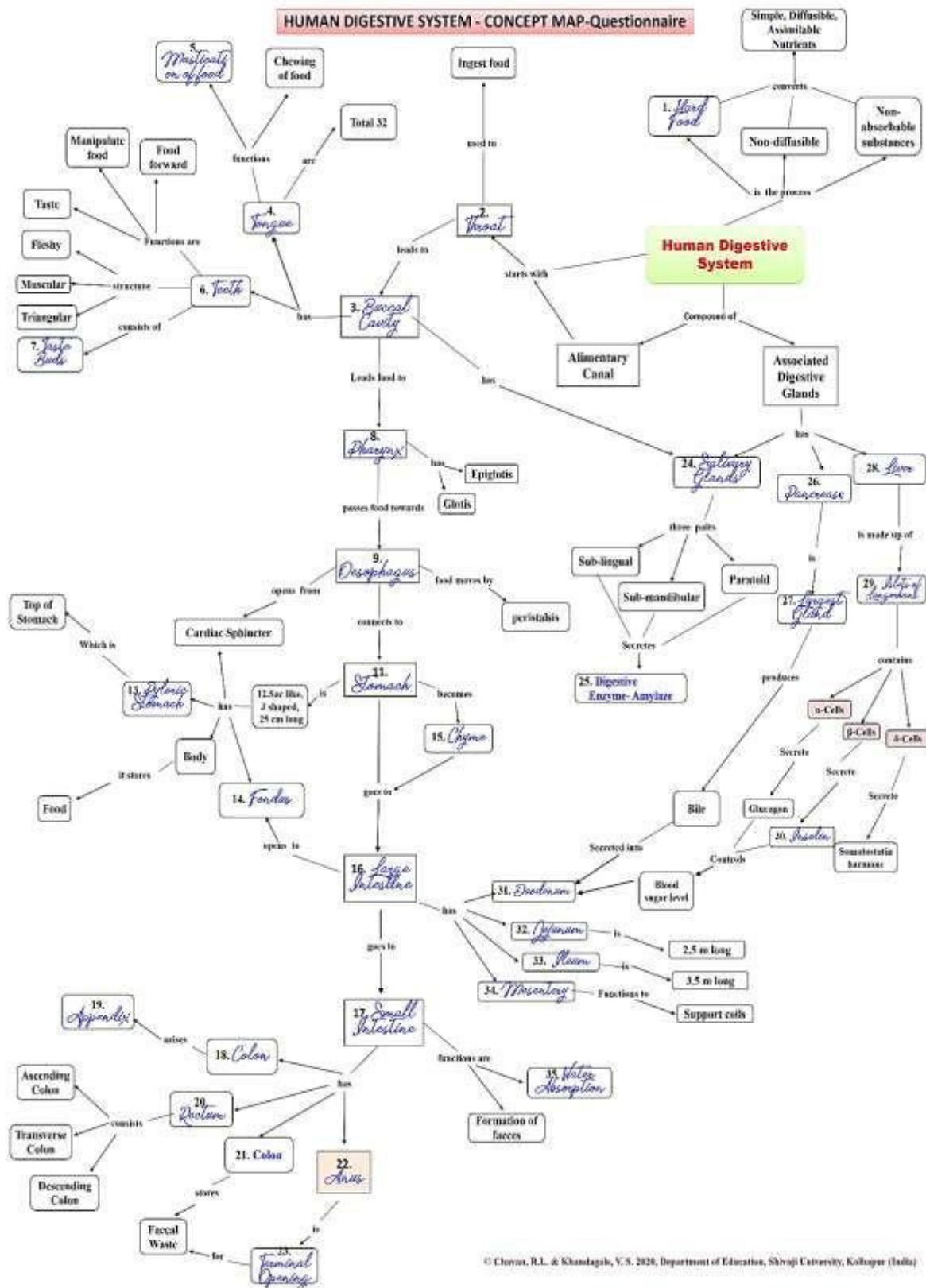


Fig. 1. Human Digestive System –Concept Map-Questionnaire

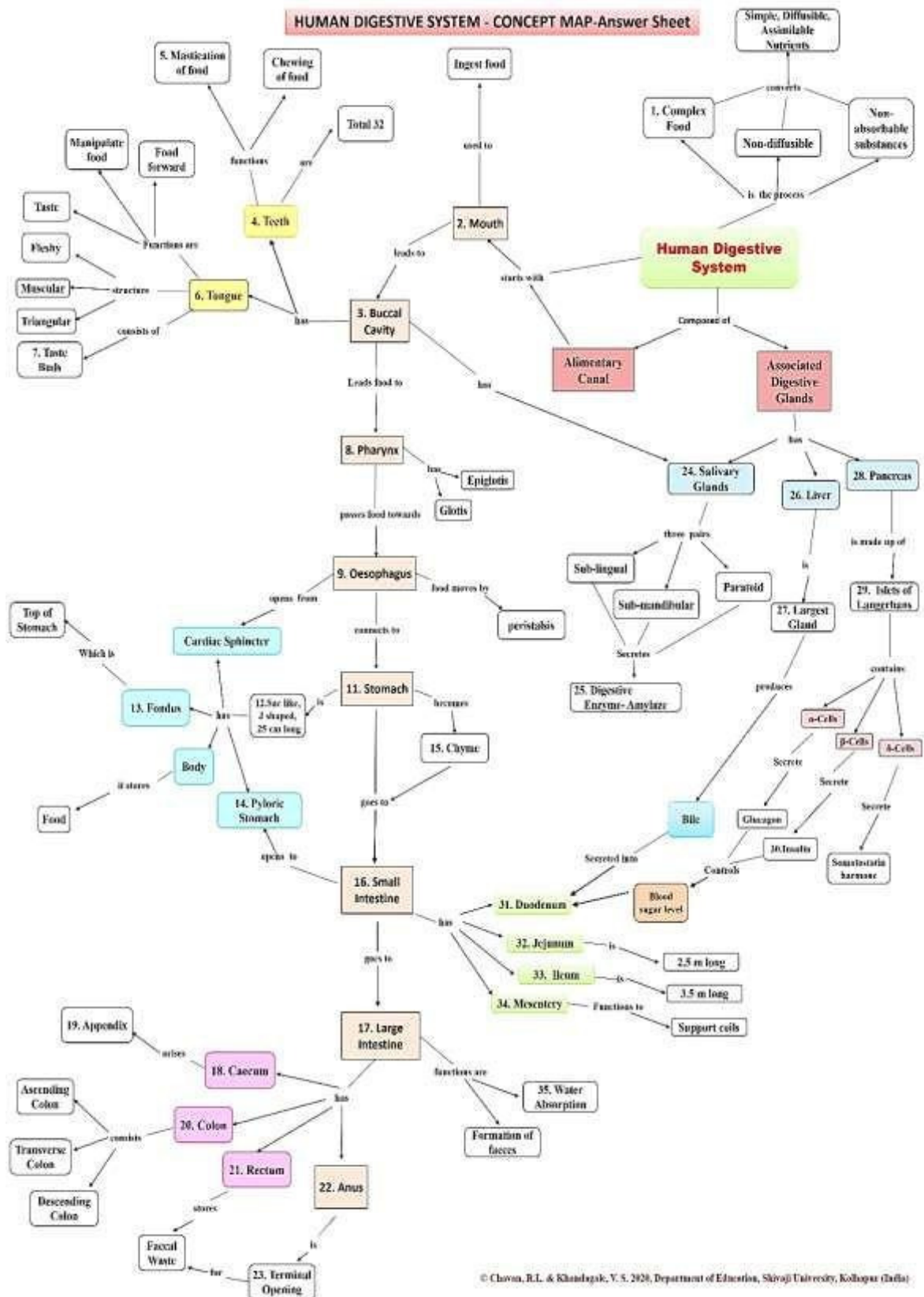


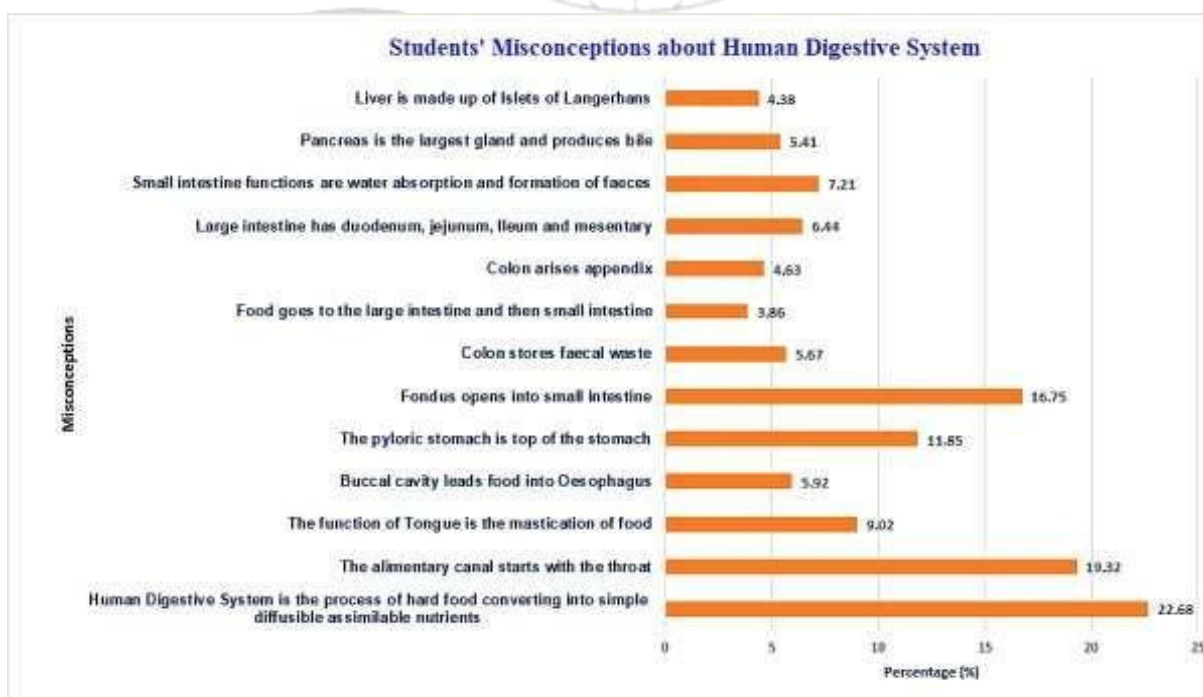
Fig.2.Human Digestive System –Concept Map-Answer sheet

Results

After thorough data analysis, important findings were found.

Table No.1 Students' Misconceptions about Human Digestive System

Misconceptions	Frequency	Percentage (%)
Human Digestive System is the process of hard food converting into simple diffusible assimilable nutrients	88	22.68
The alimentary canal starts with the throat	75	19.32
The function of the Tongue is the mastication of food	35	9.02
Buccal cavity leads food into Oesophagus	23	5.92
The pyloric stomach is top of the stomach	46	11.85
Fondus opens into small intestine	62	16.75
Colon stores faecal waste	22	5.67
Food goes to the large intestine and then small intestine	15	3.86
Colon arises appendix	18	4.63
Large intestine has duodenum, jejunum, Ileum and mesentary	25	6.44
Small intestine functions are water absorption and formation of faeces	28	7.21
Pancreas is the largest gland and produces bile	21	5.41
Liver is made up of Islets of Langerhans	17	4.38



Graph No. 1 Students' Misconceptions about Human Digestive System

From the above Table No.1 & Graph No.1 It is observed and interpreted that, the concept maps analysis revealed several misconceptions the students held about the human digestive system. The most common misconceptions identified were: A few (22.68%) students had a misconception as the 'Human Digestive System is the process of hard food converts into simple diffusible assimilable nutrients', a Few (19.32%) students showed misconception as 'Alimentary canal starts with throat', Few (16.75% & 11.85%) students have misconceptions as 'Fondus opens into small intestine' & 'Pyloric stomach is top of stomach'. Very few students have misconceptions as 'The function of Tongue is mastication of food (9.02%), 'Buccal cavity leads food into oesophagus (5.92%),' 'Colon stores faecal waste (5.67%),' 'Food goes to the large intestine and then small intestine (3.86%),' 'Colon arises appendix (4.63%),' 'Large intestine has duodenum, jejunum, Ileum and mesentery (6.44%),' 'Small intestine functions are water absorption and formation of faeces (7.21%),' 'Pancrease is the largest gland and produces bile (5.41%),' & 'Liver is made up of Islets of Langerhans (4.38%).

Conclusion and Discussion

In conclusion, the analysis of concept maps revealed several misconceptions held by students regarding the human digestive system. The study identified several common misconceptions, including misconceptions about the overall process of digestion, the starting point of the alimentary canal, the connections between different parts of the digestive system, and the functions of specific organs.

One prevalent misconception was that the human digestive system is solely responsible for the conversion of hard food into simple, diffusible, and assimilable nutrients. This misconception reflects a lack of understanding about the multiple steps and processes involved in digestion, including mechanical and chemical digestion.

Another common misconception was that the alimentary canal starts with the throat. This misconception indicates a misunderstanding about the initial entry point of food into the digestive system, which is actually the mouth.

Additionally, misconceptions were identified regarding the fondus opening into the small intestine and the belief that the pyloric stomach is located at the top of the stomach. These misconceptions demonstrate a lack of knowledge about the anatomical structures and connections within the digestive system.

Other misconceptions included the function of the tongue being solely related to mastication, the buccal cavity leading directly into the esophagus, the colon storing faecal waste, the incorrect sequence of food passing through the large intestine before the small intestine, the colon arising from the appendix, the mistaken identification of duodenum, jejunum, ileum, and mesentery as parts of the large intestine, the misunderstanding of the small intestine's functions as

water absorption and formation of faeces, the misconception that the pancreas is the largest gland and produces bile, and the belief that the liver is composed of Islets of Langerhans.

Addressing these misconceptions is crucial for promoting accurate understanding and knowledge of the human digestive system among students. Educators should develop effective teaching strategies and materials that specifically target these misconceptions, providing clear and accurate information about the processes, structures, and functions involved in digestion.

It is important to note that this study focused on a specific group of students, and further research involving larger and more diverse samples is needed to gain a comprehensive understanding of misconceptions about the human digestive system.

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