

Assessing Student Understanding of Core Principle Structure and Function

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Introduction

- Most college students rely on informal reasoning; however, principle based reasoning is necessary to develop biological literacy (Hartley et al., 2011, Wilson et al., 2006)
- Structure and function is a core concept identified in biology and physiology (AAAS, 2011; Michael & McFarland, 2011)
- Formative written assessments are a low stake opportunity for students to demonstrate their understanding (Bell & Cowie, 2001)
- Lexical analysis of written assessments may decrease grading time and increase grading consistency (Nehm & Haertig, 2012)

Research Questions

How do students understand the physiology core concept *structure and function*?

Is there a difference in student performance with recall vs. application questions?

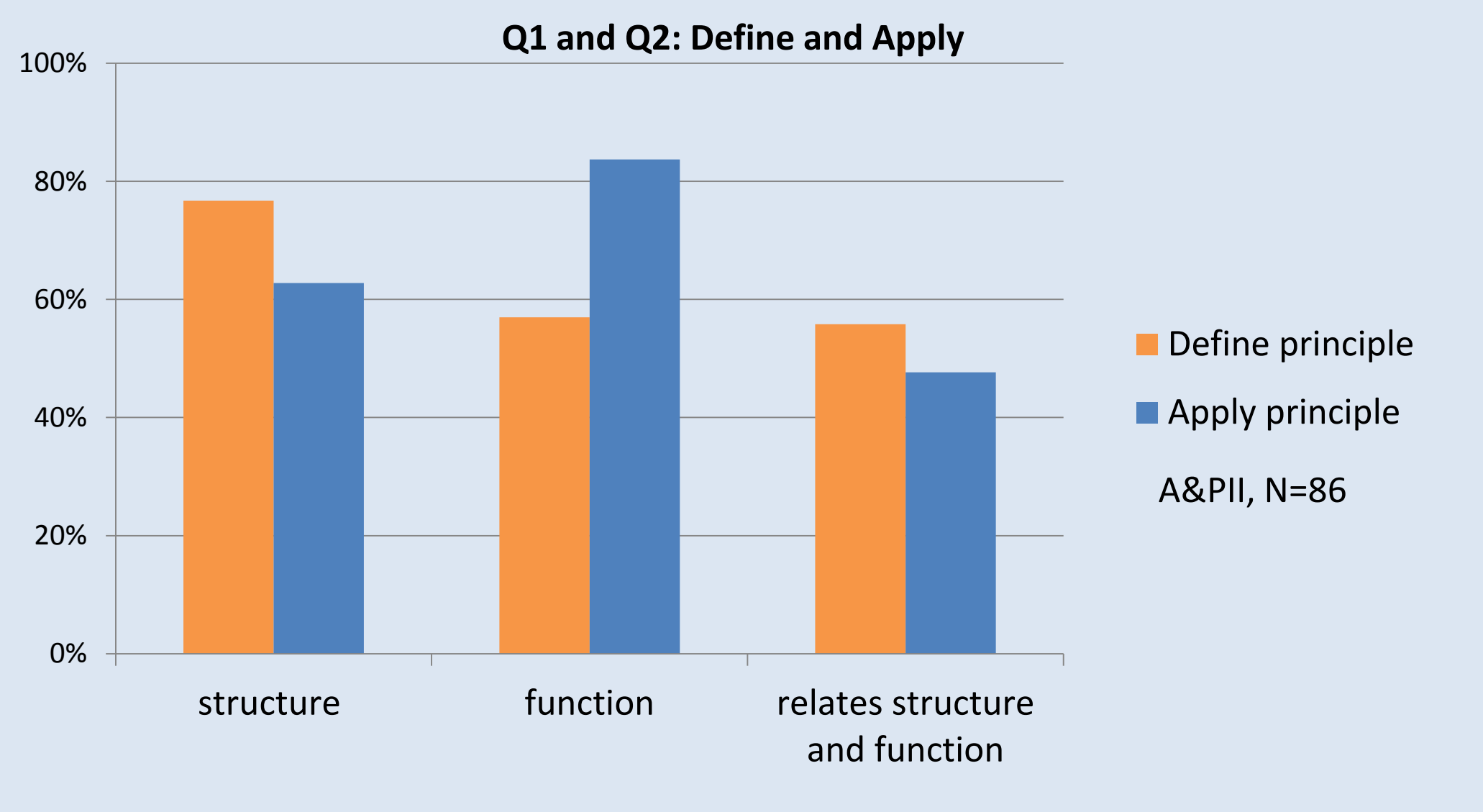
Methods & Results

We collected written responses to the questions below from students in sophomore level Anatomy & Physiology II (Q1/Q2) and junior level General Physiology (Q2) at a large southeastern public university. Responses were coded using a grounded theory approach. Using human coding and lexical analysis, we compared how these two student populations use the core concept and relate structure and function.

Q1: Define the principle: form reflects function. N=86

Q2: The structure of arteries and arterioles is important in blood pressure regulation. Based on structure reflecting function, explain how the structure of these vessels contributes to blood pressure regulation. N=185

55% of students in A&PII related structure and function when asked to provide definition, 47% related structure and function when applying the concept



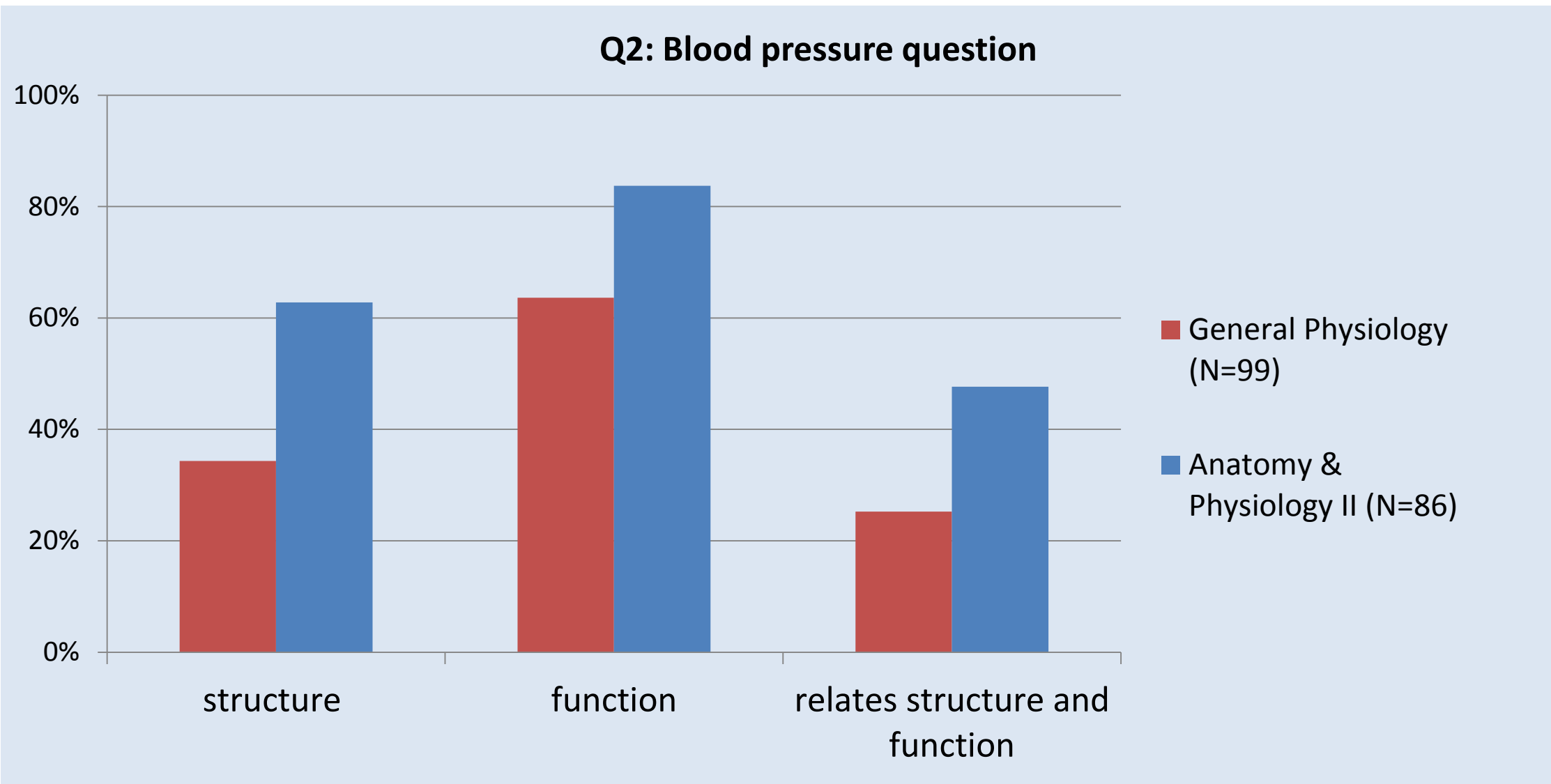
Example student responses (Q1)

...how something is formed or created usually determines how it will function. For example, the body form of a cheetah aids in its agility and speed. (*function*)

...If a chemical has a similar form the function will be similar. In anatomy it can relate to hormones or chemicals in the body as well as organs. (*structure*)

The form or structure of a cellular component, organism, etc. is related to its function as structure allows things to perform certain tasks. (*relates*)

25% of students in General Physiology and 47% of students in A&PII related structure and function when asked to apply the concept



Example student responses (Q2)

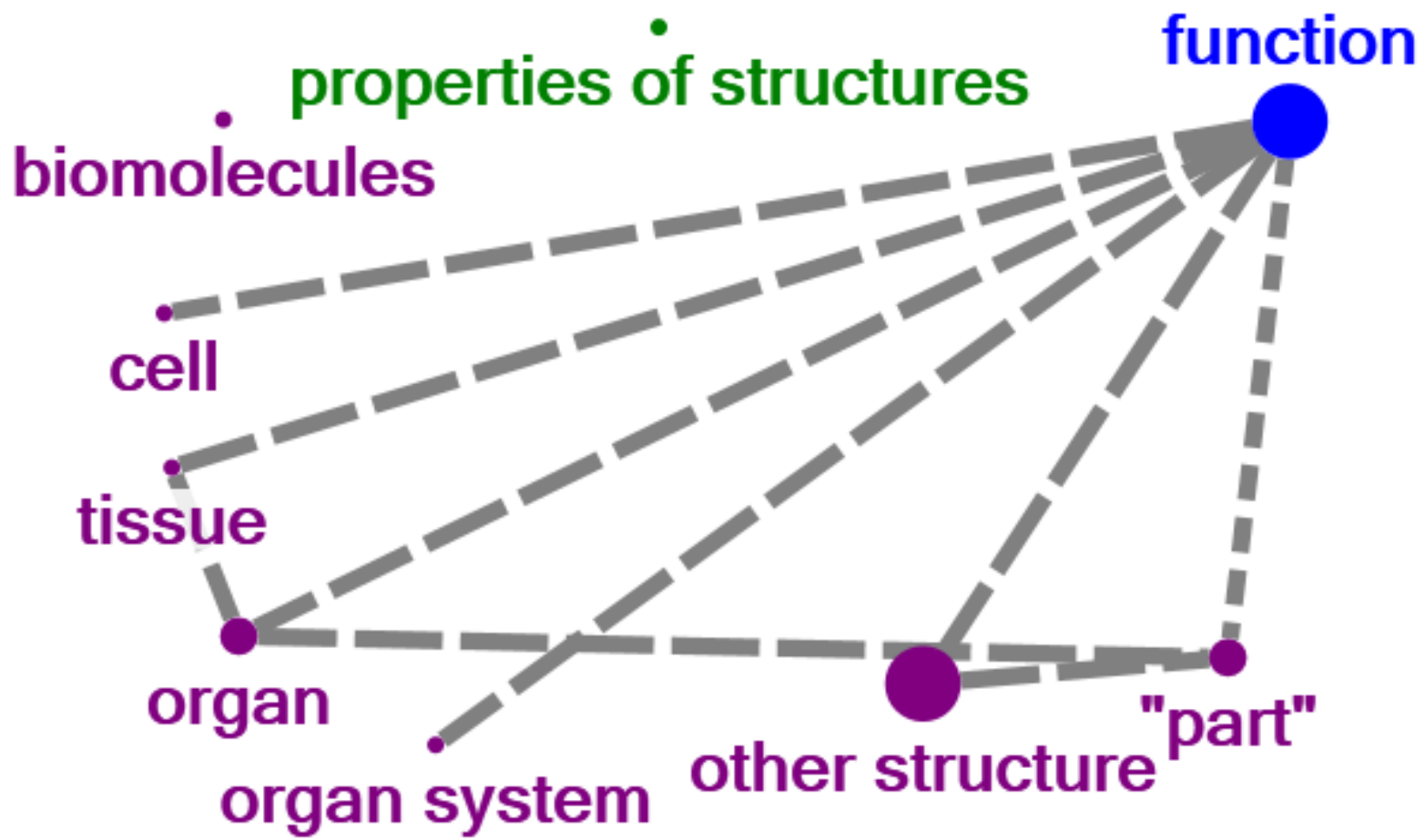
Arteries and arterioles are flexible, yet rigid, and so have the ability to not only withstand high blood pressure but are able to control blood pressure by either constricting or dilating accordingly. (*function/A&P*)

They contribute to regulation because they have thick walls and small radius inside. Therefore, they maintain blood pressure very well as the blood leaves the heart... (*structure/Gen.Phys.*)

The elastic structures and smooth muscle surrounding the vessels contributes to blood pressure regulation by having the ability to resist changes in volume during homeostasis or expand/contract when necessary. (*relates/Gen.Phys.*)

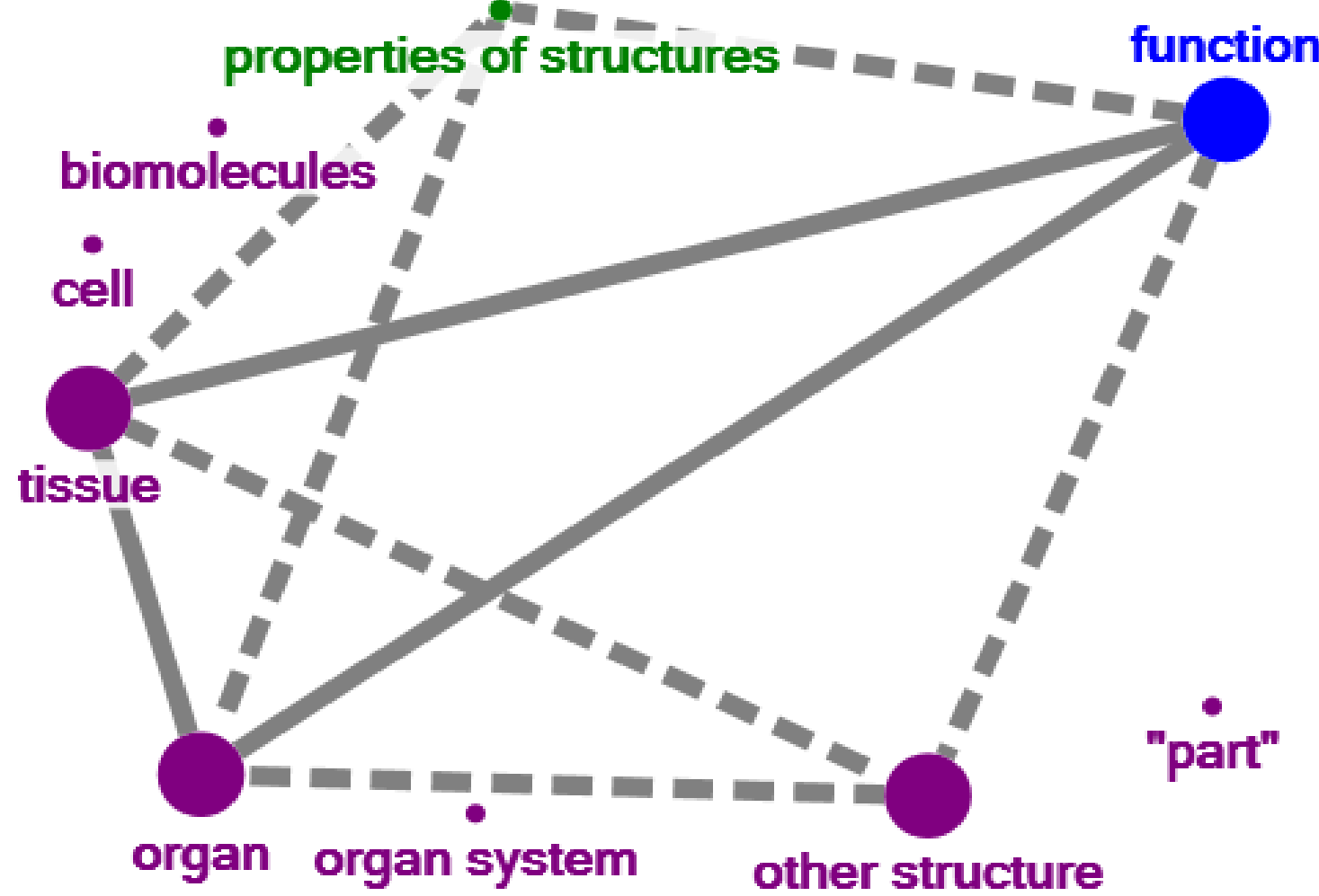
Web diagram from lexical analysis of Q1

Students use multiple levels of organization to describe structures when defining the concept



Web diagram from lexical analysis of Q2

When applying the concept, students linked more categories, and used tissue and organ



Key: ■ =function ■ & ■ =structure
solid line = >50% shared categories
dotted line = 25-50% shared categories
dashed line=10-24% shared categories
● = category >80% of responses
● = category >30% of responses
● = category >5% of responses

Students held misconceptions about:

- Relationship between resistance, flow and pressure
- Diffusion of nutrients, wastes and gases
- Blood pressure throughout system
- Direction of blood flow

Conclusions

- Students mentioned structure and function in their responses but had difficulty linking the concepts
- Students used multiple levels of organization when describing structures to define the core concept. Primarily tissue and organ were used to describe structures to apply the concept
- Lexical analysis tools can be used to measure student understanding of core concepts in physiology to assess student conceptions and misconceptions, and enhance instructor effectiveness

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