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Full Length Research Paper

Personal reflections of comfort and upset moments in leadership journey

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Leadership is one of the key factors for development of all organizations be they small or large. This study describes the feelings and thinking of the author on leadership aspects basing on his own practical experiences from being a University of Dodoma Academic Staff Association's Leader. The author was elected as a chairperson of the University of Dodoma Academic Staff Association (UDOMASA) in October 2010, and held the post for two terms of two years each consecutively as the constitution required. The author explains his leadership journey through different stages. The study focuses most on what it means to be a staff association or trade union leader in a higher learning institution. The study further provides details about glaring moments of comfort and upset while posing way forward for a harmonious growth for both institutions and members of the organization.

Key words: Leadership, Followership, politics, Power Blocks.

INTRODUCTION

This study is a result of personal leadership experiences and reflections from higher learning institutions in Tanzania. It intends to unearth what it means to be staff association's leader and what people view about it. Leadership may be perceived differently by different people depending on their economic, social and political backgrounds as well as relevant contexts and circumstances.

The study has tried to show how leadership is perceived by academic and other members of staff in general in their work place. The University of Dodoma (UDOM) is used as a reference point as it is a workstation of the author. UDOM was formally established in March 2007 following the signing of the charter by the president of the

United Republic of Tanzania. The first academic programmes commenced in September 2007.

The University has been designed on a campus college mode each of which will be semi-autonomous. The University is guided by goal, vision, mission and objectives. The goal is to increase the contribution of higher education in Tanzania's attainment of economic growth, reduction of poverty and improved social wellbeing of Tanzanians through increased access to higher education, technological innovation, generation and application of knowledge. The vision of the university is to become a centre of excellence that offers value added training, research and public services. The mission of the university is to provide comprehensive, gender

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sensitive and quality education to a broad segment of the population through teaching, research and public services in the fields of education, health and allied sciences, natural sciences, earth sciences, informatics and communication technology, business, humanities and social sciences.

The broad objective of establishing UDOM is to create in Tanzania a place where knowledge will be transferred from one generation to another, a place where through relevant teaching and learning processes human capital vested with knowledge and skills for economic development of Tanzania will be produced, and through relevant research the frontiers of knowledge will be advanced and provide solutions to the people's suffering⁶. University of Dodoma Academic Staff Association (UDOMASA) is a gathering established by the University charter for the wellbeing of all academic staff employed at the University of Dodoma.

Leadership journey starts

When the researcher was growing up in Maasai land, the two greatest influences on his life and thought were his parents (mother and father). From his mother, the researcher learnt values of hard work, self reliance, caring for others, commitment to personal affairs and general self discipline. She did not go to school but managed to raise her children in a more disciplined manner. She used to emphasize the importance of each of us to learn to lead an independent life and try as much as possible to avoid laziness which is according to her, a big enemy to personal growth and development.

The researcher's father was and is still a leader (Olaigwanani) of one of the most famous Maasai clan going by the name of Laizer. Though he never received formal education, he was privileged to attend informal education classes during colonial times where he learnt to read, write and count. Being a husband of three wives, he tried as much as possible to treat each of them fairly. What the researcher learnt from him are the values of openness, fairness, self esteem, self confidence, personal standing and tolerance. These values from the researcher's own parents were and are fundamental in his subsequent life and career development in general to present.

During the researcher's schooling, he was privileged to be a leader from standard one to high school, and up to the University as well. In standard one, he was elected a class monitor through to standard two. In standard three, he was elected Head boy through to standard six. Likewise, he held several posts in both Ordinary and Advanced levels in secondary schools. It is at this point in time when the researcher's leadership journey started. At the University of Dar es Salaam, he tested more complex

leadership experiences from students' organization known as Dar es Salaam University Students Organization (DARUSO).

This brief leadership journey is not the focus of this study. This study is centered on leadership experiences from Academic Staff Association at the University of Dodoma. When he joined UDOM as a Tutorial Assistant in September 2008, his dream was not to become a leader but rather working hard and enrolling for Masters Degree as soon as possible to be able to exercise his academic duties proficiently. Luckily enough, he was among very few members of staff who were selected to join Masters Studies (Master of Arts in Education) at UDOM just a month after being employed. He was very happy that his academic dream is now becoming true.

Two years later, that is 2010, he completed very successfully his Master degree, and graduated in November in the same year. Something interesting is that before even graduating, his fellow staff who knew his leadership background, requested him to contest for any UDOMASA leadership post preferably General Secretary or Chairperson. He must be frank that reaching the final decision for him to contest or not was not easy because he knew how difficult the job is at that particular period of time when there was not much freedom of common staff to freely air out their views.

After several consultations and plea from people especially his close friends with whom he studied with, he finally made a decision from his own will to contest for the Chairperson Post. He believed that, the truth will set him free hence even if he might be victimized as some academicians were worried; the truth must be known to all. When the truth is known to people, they will no longer fear to speak their feelings and demand their rights.

The main strategy to accomplish this mission was to create forums for people to share experiences and ideas. When he was given a chance to express himself and tell members what he would do for them upon being elected UDOMASA chairperson, he emphasized on creating forums for people to discuss and find out solutions. The forums referred here are meetings at different levels, informal consultations and electronic means of communication (group mails). Though this strategy might have been seen ineffective and inefficient at first stance, it soon proved very successful when the meeting was convened to discuss the means of addressing both academic and social challenges of the time. It was just few days down the line they were able to establish the proper way of handling problems they encountered.

The emphasis was to find out the truth of all issues to be addressed by reading various laws, regulations, guidelines and other related documents as well as consulting relevant authorities including University Management and Ministries. The first challenge the researcher encountered is to ensure that the truth about subsistence allowance of staff on first appointment was known. Though it was a very tough task, it was possible to overcome, and those who thought the researcher

⁶ Obtained from <http://www.udom.ac.tz/>

might be victimized changed their minds and joined the move.

It gives the researcher a great pleasure to learn that, he survived in his leadership as UDOMASA Chairperson for four years in two consecutive terms according to UDOMASA constitution requirements. During his leadership tenure, there were several positive changes but the most important to him is change of attitude of academic and UDOM staff in general. One plausible example is the massive support of academic members of staff to UDOMASA unlike before. It became evident that the previous fears are no longer entertained since people are informed about what is going on about employment issues.

He was also able to represent UDOMASA in Academic Staff Associations of Public Universities and University Colleges of Tanzania abbreviated as ASAs. Due to active participation in ASAs, he was later elected a Chairperson to lead and organize leaders from all Public Universities and University Colleges of Tanzania. Additionally, he was appointed a member of Tanzania Higher Learning Institutions Trade Union (THTU) executive committee at National level. His humble background may have helped him to be trusted to this high position.

Description of leadership

Leadership can be described differently by different writers and scholars. Many old renowned scholars share common understanding about the meaning of leadership. They all seem to agree definition of leadership to mean; ability to influence, process of influencing, social influence and the ability of an individual to motivate.

It is therefore fair to be summarized that, leadership is about the ability of a person to influence and inspire others (followers) towards achievement of the desired goals and objectives. The focus is on creating common understanding of the people and bringing people together towards a set goal. Of recent, many scholars have tried to define leadership in relation to organizations.

Bushra and Ahmad (2011) argue that leadership plays an important role in determining employees' commitment. Hewitt (2012) explain leadership from the point view of creating conducive engagement culture. Emphasize is that engaging leaders who engage others are not just nice to have; they are the key ingredient to creating a culture of engagement that sustains business results in an ever-changing and complex global environment. Ransdell (2014) view leadership as both an art and a science implying that, someone needs to understand what leadership entails before applying relevant principles to execute functions.

Leadership, according to this study perspective is likened with a magnet that pulls things towards itself. Just like a magnet, the leader must be endowed with certain potentials that enable him or her to mobilize or attract

more people towards common understanding and interests in a natural way. Influence and followership are the two words that can best explain what leadership means. While influence is centered on a leader, followership is on the people or group of people who trust a particular leader.

METHODOLOGY

This study was basically written focusing on Scholarly Personal Narrative (SPN) supported by documentary review that is, documentary review is used to support and explain the researcher story, rather than the other way around. This was a methodology developed by Nash in 2004 to guide writings or works from individual experiences. It is relatively a new kind of writing and research whereby someone is allowed to tell his or her own story in a scholarly way, to make a difference in the world. It is this paradigm that motivated the researcher to write his own observations and experiences as academic staff leader in higher learning institutions drawing from comfort and upset moments.

This study aims to contribute to experiences about the situations which association or trade union leaders encounter during their tenure. By so doing, leaders will be in a position to perform their leadership duties efficiently and effectively. This methodology has been used by other scholars in their studies. Among them is Sandra (2014) who used the methodology to develop her PhD thesis titled *We Shouldn't Even Know Each Other: A Scholarly Personal Narrative of the Development of Deeply Reciprocal Relationships Across Differences of Race and Class*. This is an indication that, the methodology is widely accepted to the extent of being used to guide development of PhD thesis.

Another scholar who used SPN is Kamaara (2011) who shared personal story about *Towards a Culture of Quality Management at SASS, Moi University*. SPN gives general conceptual guidelines but does not restrict flexibility to allow authors to arrange their works and themes to suit respective contexts. In regard with permission, SPN is based mainly on personal storytelling and documentary review hence, the author was not obliged to seek for permission from authorities but need to be objective in sharing story.

RESULTS

After understanding the background of the author and description of leadership, it is necessary to present what actually happened (results) during leadership tenure of two years. The results of this study are presented in three categories. The categories are perceptions of members towards leadership, comfort moments and upset moments. Each category is detailed in the following sub sections.

Perception of UDOMASA members towards leadership

There is enough literature about qualities of leadership in general. This study however is introducing new qualities of leadership specifically related to staff associations or trade unions leadership. These qualities are based on the way members of association or union would wish to see

their leaders appear or look like. From my personal experiences, the following are the perceptions of UDOMASA members which are actually qualities of the leader they require.

A leader is a public property

Leaders as public properties include being accessible by all people all the time when necessary and understanding to avoid segregation. All the people must feel free to share experiences with him or her. Above all, the leader must be ready to spend most of his or her time to serve people. During the researcher academic staff association leadership, he was expected to serve and listen to academic staff concerns only and not otherwise.

In due course, he came to realize that it was not a case since all UDOM staffs were expecting him to represent their views and concerns in governance organs of the University. They believed that academicians' voice and demands are the voice and demands for all, and whenever academic leaders address their issues to the University Management for discussions and common solutions, administrative staff's concerns are automatically covered either directly or indirectly.

The researcher was therefore reminded by people that "*bear in mind that, you are a public property*" meaning that he ought to understand and address issues from all university staff inclusively, and not just a section of it.

A Leader as a dust bin

This refers to preparedness of a leader to accept blames, insults, mocks, despises, etc, even if all of them are to be skeptical, baseless and unfounded. Through his leadership experiences from UDOMASA, he encountered several baseless allegations from time to time that he has been tainted by University Management that is, given money to be silenced. This happened when members' wishes were not honored on time due to various reasons which were sometimes genuine. Additionally, he was labeled a money monger by some people because of attending meetings which have paid allowances and also travelling to various meetings outside the University where he received per diems and bus fare allowance. Most of the time when he wanted to express his disappointments or dissatisfactions, he was told to just ignore them because "*a leader is a dust bin*"

A leader as shock absorber

A leader must be able to contain any information given to him or her, and handle it properly. This means a leader is required to control his/her temper to avoid mishandling of sensitive issues that might arise in due course. In the

researcher's leadership experiences, people used to tell him that leaders are shock absorbers in the sense that they must be ready to receive sensitive information and handle it accordingly.

A leader as stable person

A leader should be firm and focused to avoid being derailed by events and circumstances. Emotional and psychological stability is very important to leaders. A stable leader is the one who can discourage all those irrelevant thoughts or ideas from the people. Leaders must be able to show the way not entertain followership tendency, that is, being influenced by mobs even when unnecessary.

A leader as problem solver

A leader is supposed to appreciate that challenges and conflicts are a fact of life in organizations. Crafts of how to deal with these problems are required. Problem solving can be done through creating awareness, discussions, meetings etc. Some of the problems are caused by lack of information. More important is that staff association/ union leaders must form link between management and staff.

A leader as creative figure

A leader must be creative in leading people. Creativity involves skills on how to chair meetings in a productive way, how to solve problems meaningfully, how to interact with people of different calibers etc. Peter et al. (2011) as well as Peter and Marc (2015) insist the need for leaders to be creative in the rapid changing environment in Universities. Association/union leaders are not exempted from this move.

A leader must be informed

A leader must be on alert all the time to ensure that any useful information is known to him in order to avoid rumors and parochial conclusions in decision making. Employees always think that a leader is informed about everything going on in the organization. Apart from general information that employees would wish to hear from leaders, they sometimes ask even those information that fall under purely administrative docket. A good example is when the researcher was asked about when the salary will be released. It is believed that a leader's voice is embedded with sort of power and authority hence must always be released carefully. The researcher remembered his second master during his ordinary level

studies who used to insist that in quote “My Voice has authority to you”. People take leaders’ information in a very serious note, and they can quote it anywhere, where necessary. *Information is power.*

Good public relation person (Good rapport engineer)

A leader must be able to establish good relationship with many people of different types, and all levels as much as possible. This can happen only when a leader appreciates that each person has his or her role to play in the accomplishment of organization’s goals. The university employs workers of different academic qualifications and experiences. Being an academic member of staff should not mean that someone is everything. Office attendants, drivers, accountants, artisans, wardens, security guards etc are very important people to make the institution operate smoothly. According to many people, a leader is the one who can interact with all people regardless of their skills and experiences

Caring one

A leader must be very keen in understanding people’s wants and look for means to solve them. During the researcher’s leadership, there were several problems facing members of the association. What the researcher did was to try to understand the nature of each problem, and establish appropriate way to solve it. One of the vivid examples he remember about this case is when he helped UDOM staff who were studying at various institutions outside UDOM within Tanzania to clear their loan requirements in their absentia.

Consistent one

A leader must be reliable in all his or her undertakings. This means that a leader’s stand should not fluctuate to avoid confusion to members or followers. Leaders must be predictable in their philosophy and ideologies to build trust among people.

Future creator/visionary

A leader must be able to lead people in realizing their future. It involves informing people how to behave and act in manners that direct them to achieve a reasonable future. Basically, through the researcher’s leadership, he had experienced role as the one who articulates and put into action a vision for a future that inspires others to join in. One of the examples he remember is to insist on the importance of every staff to struggle and have his or her permanent place of residence. This was done by encouraging staff to borrow loans from banks and join

SACCOS so that they increase their financial muscle not only by building a house but also performing other social and economic activities.

Transparent and authentic figures

Leaders must be true to themselves, and always open in their actions. There is common wise saying which states “charity begins at home” This saying can be used in different contexts to explain different meanings. In this context, it is used to insist that all leaders should be able to behave, and act in candid manner to reflect openness and trustworthy.

A leader as accountable fellow

A leader is the one who is ready to be answerable to all his actions whether positively or negatively. For objectivity purposes, the leader is required to systematize all his or her undertakings so that fair judgment can be reached whenever answerability is required.

Selfless person

Leaders should portray high level of commitment in serving their followers. Selflessness referred to here is when a leader can avoid serving own interests through his or her position. Selfless people are now days considered very rare species that is, they are there but rare. Some even believe that selfless leaders can only be obtained from God’s wishes, and not within the realms of human capacity.

Perception of association/unions’ by management

It is sad to know that, sometimes trade unions and staff associations are considered by authorities as trouble makers, and more wage dispute oriented than helping the institutions to accomplish their functions. From the researcher’s experiences as a retired UDOMASA chairperson, he is convinced beyond doubt that, staff associations and trade unions are the important vehicles in organizations that can facilitate presence of peace and tranquility. It is therefore fair to pose a challenge to all University community and specifically the University authorities at all levels to change their perceptions towards the role of trade unions and staff associations. Instead of pointing the finger at one another and shifting blames to others for bad outcomes, the whole university community should join efforts together towards fulfillment of the desired objectives.

Comforts moments of leadership

There is a general perception that leaders are enjoying

lots of benefits accruing from their positions especially financial resources. The researcher feels like explaining some of the benefits he found more important and proud to talk about during his leadership tenure. These benefits are the ones he consider to be comfort moments when in leadership.

Exposure

Becoming a leader is an opportunity for one to get exposure to new skills and experiences from different people and situations. UDOMASA leadership has enabled the researcher to become aware of so many things which he would not be able to know. He has expanded his horizon of how to address staff affairs at different situations and circumstances in a more successful manner.

Network

Leadership has enabled the researcher to come across with many people of different positions and caliber. It is through UDOMASA leadership where he became chairperson of Academic Staff Associations of Public Universities and University Colleges (ASAs) in Tanzania. He also attended several meetings at the Ministries responsible for higher learning institutions such as Ministry of Education and Vocational Training, Ministry of Finance and President's Office Public Management and Civil Service. In all these meetings, it was easier to come into contact with people of different positions and experiences.

Confidence

The researcher feel like someone who gained more confidence through leadership due to the fact that he is more informed than before being a leader. Since he attended several meetings within and outside the University, he was able to build confidence on how to handle staff and other affairs. The researcher also feels a person who is more mature psychologically and emotionally than before.

Challenging and tricky (upset) moments in my leadership tenure

Some of the moments in the researcher's leadership undertakings were very rough, challenging and tricky. These were the moments he can call "all eyes on me" implying that, all people including UDOMASA members, University Management, the Government and the Public at large were keen to see his stand at those desperate times. The following are some of the situations which explain tricky moments during his leadership.

Presiding over controversial meetings

One of the challenging and tricky moments are the days when Academic Staff members were very upset to the extent that they wanted nothing but industrial action to express their discontents. One of the most notable instances he remembered among many is the joint meeting between the Vice Chancellor together with his team and all academic members of staff in Chimwaga Complex Hall on November, 12th 2014.

Academic members of staff raised a number of issues they were unhappy with the way they are addressed. It was a challenging moment to the researcher since all academic members of staff were determined to undertake industrial action in the presence of VC. He remembered during that time, General Assembly of the ruling party CCM was in Dodoma conducting its elections. This means that the whole government clique was in Dodoma and they knew very well what was happening in their former Chimwaga Complex.

The meeting was very hot and that it lasted for two days consecutively from morning to very late hours in evening. The researcher had to be very firm but fair to all parties present in that meeting. He did not allow any person or group to victimize the other, mislead the intention of the meeting and any other unbecoming act which could have ruined the smooth running of the meeting. Being fair but firm as a chairperson of the meeting, the discussion went very well and lastly common understanding was reached. It enabled the members of academic staff to realize and change their intention to wage industrial action and allow dialogue to take its due course in addressing all challenges identified. It is therefore a great pleasure to the researcher that he was able to settle down the situation amicably. There are other instances of this nature and many more that happened in subsequent time but handled in a calmer manner. Through these events, he learnt that leaders should take into considerations the following key issues during tough moments;

1. To be very fair but bold enough in reaching conclusion to avoid being swayed
2. Allow enough time for discussions and deliberation of issues
3. Tolerate people to provide solutions of their own to controversial issues
4. When people trust a leader, nothing can go wrong
5. Dialogue is an opportunity to let people meet and discuss matters of concerns.
6. If the boss of the institution has good will and passion towards affairs of staff, it is very easy to reach consensus and compromise in respective organizations.

Internal faction politics

UDOMASA being an interest group that influence policy

making in its favour, is not isolated from natural outgrowth of internal power blocs that is, groups within UDOMASA itself to advance their interests. It is a common phenomenon that, in all social groups, a special interest group is likely to band together as a way of achieving their goals and advancing their agenda and position within an organization. This situation will form what is known as internal politics within itself that is, within the group itself.

According to the experience of researcher, UDOMASA internal politics was not very intense since the group is still growing in number and experiences. Some people might think that politics is something related to political parties and national politics only. To make clear this notion, politics is any ideological activity, strategy or means performed by any person of any level regardless of his or her status to gain certain advantage. Personally as stated earlier, he did not experience strong internal politics due to a simple stated reason that the group is not yet mature enough to experience interest groups.

During his leadership tenure, the main focus was to establish the identity of the association through building stable systems and networks within and outside to make it live longer. The researcher is however confident that, internal politics could not have scared him since he is well-versed with organizational political techniques and strategies popularly known as micro politics commonly applicable in institutions.

Few cases of internal faction politics

The researcher think it is unfair if he do not mention few cases where power blocs were featured in his leadership tenure. As he explained in the previous paragraph, politics is part and parcel of life of any social groups since some people would wish to see their interests being honoured all the time. If they do not see their interests being realized, they resort to political propaganda as a means of consoling themselves. Since some people were not always happy with the style of his leadership, they lastly engaged in the game of politicking. Some of the blames (micro politics) he remembers waged against him are:

1. Allegation that at some points in time, he abandoned members of academic staff who were terminated from employment.
2. Allegations that, he was not ready to delegate power for example allowing someone to attend meetings (Council) on his behalf.
3. Claims that it reached a point he was no longer strong as compared to the beginning just because he was against industrial actions.
4. Blames that he established a good rapport with the University Management something which according to them would have threatened his stand point;
5. A claim that he always defend members of academic

staff alleged to commit mistakes; and
6. Questioning the possibility of surviving in chairmanship position without being victimized by authorities for two terms consecutively.

Techniques to handle groups

These few cases earlier mentioned and many more of this nature was the centre of political propaganda during his leadership tenure. The point to emphasize here is that this propaganda is bound to happen in any social group. This must be very clear to anybody entrusted with position. Some people were also questioning how he managed to persist without victimization by authorities. Personally, he was able to survive throughout his tenure despite internal power blocs. The main strategies he applied to counteract and contain propaganda and grievances included, among others, the following;

1. Conducting UDOMASA general meetings as per almanac to give people a chance to air out their views and release tension. UDOMASA constitution requires that general meetings be conducted once every three months. It was properly implemented.
2. Avoid giving ambiguous statements – he tried as much as possible to explain himself to keep away from vague statements which could disturb attention of members. It reminds him of the moments he always urged academic members of staff to be objective in whatever they do.
3. Communication using UDOMASA mail group – We created UDOMASA Google group mail to simplify sharing information among members. All sensitive information was circulated to members hence keep members informed all the time
4. Active participation in social affairs – Social events especially funeral and the like are very fundamental in uniting people. He participated fully in these events and therefore maintained trust among the people.
5. Enthusiastic representation of the members in governance organs of the University that is, council meetings – he was very firm to represent his fellow members in all council meetings and shared information to members promptly.
6. Stick to procedures – he had to stick to procedures guiding the association especially the constitution to avoid being misled
7. Participatory decision making – All decisions about the association were exhaustively discussed and solutions found by Executive Committee. The members of Ex-com are drawn from all schools and therefore they were ambassadors to what have been deliberated.
8. Understanding expectations of members and prepare answers in advance
9. Detaching from misconducts of any kind to avoid creating a loophole of facing disciplinary or criminal actions.

10. Informal talks, meetings and consultations – Informal consultations were very fundamental in calming situations. Some members were more comfortable to give out their views informally and not publicly. Their good views were taken on board

11. Being alert to information – Being proactive and alert to sensitive information is an important way of managing internal politics and surviving in positions

12. Resorting to soft war that is, non violent strategies such as identifying needs and addressing them by writing. These soft wars are very effective and usually end with less or no injuries

13. Being fair to everybody to avoid biases – This helps to show people that what you are dealing with are not personal interests but the affairs and needs of the general population.

14. Reading and understanding labour laws – It helped to avoid being trapped as well as in advising fellow staff to abide by stipulated rules and regulations

15. Expanding networks and alliances with THTU and ASAs – Walking alone in leadership is sometimes dangerous. Knowing this, he attached myself to trade union and academic staff associations in Tanzania to join efforts towards set goals.

DISCUSSION

The results presented bring to attention three important things to discuss. The first one is that, leadership qualities for staff association/unions are almost the same with the commonly known general qualities of leadership. However, qualities attached to staff/unions leadership are treated in serious attention by members. The reason is just simple that, association/union leadership is more of personal sacrifice unlike organizational leadership guided by laws and regulations.

Association/union leadership's main instrument is power to influence through personal attributes (charisma) and not laws. This does not mean laws are useless but not the main guide to this category of leadership. The second important thing is the fact that comfort moments experienced by association/union leaders are different from those expected by the members. While leaders experience non-monetary benefits accruing from their position, members believe that leaders receive a lot of money for the virtue of being leadership. This is a contraction which sometimes may lead to misunderstanding between the leaders and followers. The third thing is about upset moments whereby leaders need to be aware of the fact that these moments are inevitable in leadership. What matters to leaders is to be versed with all requirements of the group and address them accordingly.

Following the discussion therefore, there should be deliberate attempts to create awareness to all members of staff about how the University operates. This attempt

includes making them understand the university structure, governance organs of the university, university leadership, distribution of responsibilities, and many more of the like. By doing so, members of staff will be able to perform their duties in a more comfortable and successful manner. Joint efforts should be directed to the following key areas

Creating awareness to members of staff

A new staff orientation is necessary for both academic and non academic staff. For academic staff, a course on pedagogy and university culture especially for staff coming from teaching non schools or autocratic organizations.

Improve communication

Without proper organizational communication, it will be very difficult to achieve the intended objectives. Communication is an important requirement just like the way blood is important to human beings. The researcher would like to recall all members of staff and the university community at large that the Tower of Babel was not complete because of breakdown of communication after confusion of languages. We should not fall into this trap but always remember that communication is lifeblood of the organization.

Ensure accountability and transparency

Openness and answerability should be the main pillars to guide all organization members in fulfilling their responsibilities. All organization undertakings and duties performed should be done openly and in a participatory manner to avoid suspicions among members.

Seminars and workshops on labour and public service laws and regulations

Seminars and workshops should be conducted from time to time on different laws and regulations to make members of the organization conversant with those legal basics. The researcher do believe that, when members of staff are aware about public as well as labour laws, suspicion and unnecessary pointing the finger at one another will be minimized.

Monthly meetings

The university management has already consented joint meetings between UDOMASA leaders and university

authorities to be scheduled on monthly basis purposely to discuss and resolve concerns of staff. It is good news to all of us that these meetings have been taking place and in fact solutions to some issues were found. These meetings are important forums to discuss non-policy related matters.

CONCLUSION

The whole study can be concluded by pointing out some few points which are;

1. First and foremost, becoming a determined staff or trade union leader is a huge sacrifice one can make in life. The reason is just simple that one is subjecting him/herself in risks like losing employment or being harmed by crooks.
2. Secondly, the researcher is glad that he had managed to convince UDOMASA members not amend the constitution to allow him contest for the third time consecutively. It was a big trial to him considering the fact that even ASAs members had a plea to him to contest for lower UDOMASA position.
3. Thirdly, since the researcher was able to interact with government officials at different levels and positions, he realized that, without being smart and persist in following up matters, it is more difficult to achieve what you have planned.
4. Fourthly, all leaders must always remember that followers (members) are people of different nature and characters. It is suggested that a leader understands these variations and learn how best to contain them to circumvent unnecessary prejudice
5. Lastly, serving people in leadership capacity is a blessing position. Hence, people should not be scared to take up positions.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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Full Length Research Paper

Relationship of the cognitive functions of prospective science teachers and their knowledge, knowledge levels, success and success levels

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This study reveals the transformation of prospective science teachers into knowledgeable individuals through classical, combination, and information theories. It distinguishes between knowledge and success, and between knowledge levels and success levels calculated each through three theories. The relation between the knowledge of prospective teachers and their cognitive functions is defined through the results gained from three theories, and a case study that collected data through problem solving techniques in the procedural knowledge of electricity. The results reveal that prospective teachers have problems with such knowledge, which may explain why cognitive automatism is not used. Since processes of understanding are not used in cognitive automatism, it appears that prospective teachers are individuals that may differ in terms of their learning but do not use their cognitive functions. The study suggests that if the knowledge levels of independent variables are increased, cognitive functions may develop.

Key words: Classical calculation, cognitive automatism, cognitive functions, combination calculation, information calculation.

INTRODUCTION

It is important to separate knowledge and a knowledge level, and success and a success level, in developing cognitive functions. Analysis of individual knowledge can be achieved through this separation. By using inference, the thinking and decision-making components of cognitive function procedures, individual knowledge can be developed. Success is based on the existence of procedural knowledge in terms of the structure of a cognitive domain. However, success is not merely based on the procedural knowledge of our cognitive domain.

External factors also affect success. Some studies show that teacher professional development (Franke et al., 2001; Roth et al., 2011; Saxe et al., 2001); teacher content knowledge (Heller et al., 2012; Hill et al., 2005; Kanter and Konstantopoulos, 2010); teacher pedagogical content knowledge (Heller et al., 2012); and teacher knowledge, skills, and practice (Cohen, 1990; Wilson and Berne, 1999) also influence success.

Although, researchers agree on this matter, there is a need for strong and clear evidence teacher professional

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development on specific effects. For instance, there is limited convincing proof of the influence of teacher professional development on success (Wayne et al., 2008).

For stronger evidence, knowledge, the knowledge level, success, and the success level must be precisely defined. In this way, strong proofs about the relations between dependent-independent variables can be obtained, which will lead to the development of cognitive functions. Knowledge can be analyzed by the knowledge level and symbolic level; however, when an individual acquires the data consisting of knowledge using his cognitive functions, do the knowledge level and symbolic level have effects? What is the meaning of the knowledge level and symbolic level during education-learning processes? In order to answer these questions, information theories should be used in the assessment and evaluation because the symbolic level involves the study subject of information theories.

Developments in neuroscience have brought innovations that help us understand the development of cognitive functions. Moreover, neuroscience also puts forward data about how educators should teach students. These data are more about the definitions of cognitive functions than effective learning (Oliver, 2011). The operation of memory is defined by the interaction of many cognitive functions, and yet it is not clearly defined by cognitive functions (Bledowski et al., 2010).

In creative thinking, the roles of various cognitive functions are important for learning. How the roles of a particular cognitive function can be included in problem solving is discussed in the literature (Gregory et al., 2013). Can knowledge, the knowledge level, success, and the success level be used in the development of cognitive functions? How each of these concepts can be developed by cognitive functions? Answering these questions requires not general descriptions but specific, specialized definitions.

The objective of this study is to reveal the knowledge of prospective science teachers that is the product of their cognitive functions, how this knowledge can be enhanced, and how these teachers can be transformed into knowledgeable individuals. In this study, the relations between knowledge, success, the knowledge level, and the success level and cognitive functions will be determined and suggestions will be made in order to enhance knowledge of these future science teachers.

THEORY

Conceptual theories

In science teaching, the logical foundations of cognitive functions can be developed. "Understanding" has critical importance in defining cognitive functions, knowledge and thinking. Understanding, one of the cognitive function

processes, is defined by Özenli (1999) as a part of cybernetic and mathematical logic. He writes:

In the flow of input information or data, the conceptualization of the integration of cognitive modules that seem relatively independent from one another in the high structured semantic web and, therefore, solving the interpreted code in semantic memory unit by transforming "procedural knowledge" into declarative knowledge! Only if this is possible, does "understanding" occurs. Otherwise, this process/these processes create a "before understanding" state in order to understand the subject and this continues until the understanding occurs. Such scientifically structured understandings will remain within the frame of mental functions and the contemporary scientific-technologic structure (p. A7).

The definition of understanding first requires dividing data into its cognitive modules, and then integrating them. This approach ensures measurable definitions of cognitive functions, knowledge, and thinking. The knowledge that is produced as a result of the understanding processes is declarative knowledge for the individual that produces it and data for other individuals.

Data, visual and tactual imprints are not the sole components of "knowledge." "Knowledge" also includes inference, thinking, and decision-making components. Creating the semantic coordination among subunits of data using logic rules, mental mutation, and recombination produces "thinking" (Özenli, 1999). In order to use cognitive functions in thinking, data should be divided into its variables; these variables should be divided into their cognitive modules; and the possible states of each cognitive module should be determined. The possible states of cognitive modules will be called sub units. With the semantic coordination of the cognitive modules of variables, logic rules, and mental mutations, combinations among sub units will be constituted, and the cognitive modules of sub units decided by recombination will be knowledge. Such knowledge through cognitive functions is a product of thinking. This definition of knowledge can be called a "possibility-probability knowledge theory."

If an individual can solve the problems that she confronts in the frame of the things learned during her formal learning process and can apply what she has learned, she is not knowledgeable according to the definition of knowledge aforementioned. In this case, individuals can be compared with other individuals based on "better or less educated" because education compulsorily provides what an individual should *already* know; therefore just because she knows what she should already know does not make that individual knowledgeable (Özenli, 1999). An individual's application of what she has learned during her formal education process can be a result of cognitive automatism. For cognitive functions, cognitive automatism is necessary.

Understanding and cognitive automatism associates by Özenli (1999) are;

The logical foundations of the cognitive functions of human beings represent the “operational concept of wisdom.” There is no doubt that for the structure of this cognitive domain, the existence of a remarkable amount of procedural knowledge should be accepted. This information automatically emerges through books and publications that include graphic-pictorial, statistical, and semantic features and by reconciling cognitive actions. Subsequently, this cognitive automatism is always ready for action. When the circumstances that are necessary for them emerge (for instance, the emergence of a familiar concept or a word in a related field) can result independent images, intentions that are not realized by mind or conscious. Since this automatic processing is performed by sub units (or modules), it does not influence the operation of parallel sub units. Automatism gives us a holistic spectrum of possible interpretations or explanations of a circumstance and the related behaviors and is not yet related to understanding. However, when this broad spectrum created by cognitive modules, when related, can be degraded into a single understanding that includes maximum data with minimum terms, “understanding process” occurs and this defines the difference between cognitive automatism and understanding process (pp: A7-A8).

In order to increase the knowledge of prospective teachers by transforming cognitive automatism into understanding, defining knowledge, the knowledge level, success, and the success level are important, since there might be differences in the measurement tools, objectives, and techniques of education. What really matters are determination through assessment-evaluation tools of whether feedback (knowledge) is sufficient and productive. This shows us where and how we are deficient. At the same time, right proofs lead us to solve problems.

Mathematics-statistics theories

Cognitive function operations can be made by data or information cognitive modules and sub units. These modules and sub units represent knowledge and success. In his study, Yılmaz (2011) recommends defining and scoring cognitive modules of data or information as the smallest significant parts (akp). If data are used to produce knowledge, the akp_b here represents knowledge. The akp_b of result data represents success. Digitizing by scoring data and information enables us to assess mathematically understanding and cognitive function operations, and therefore analyze with “objective logical simplicity.”

In this study, in order to determine knowledge, success,

and the knowledge and success levels, the scoring system of akps of Yılmaz (2011) study will be used. After scoring, operations can be carried out by lowering them into two possibility cases (probability $\frac{1}{2}$) in information and probability theories on “akp” in assessment-evaluation.

In this study, operations will be made for equal probability (1/2) cases and positive scores. In classical calculations, the definition and formulas of VDOİHI combined the staging technique given below; it will be used. The definition and formulas of the VDOİHI combined staging technique that will be used in the calculations of information and probability (combination) are given as follows:

Classical calculation

Classical knowledge and success calculation

VDOİHI is a statistical technique that is based on comparing akps of theoretical and experimental data. Theoretical data are divided into its akp_b . After this division, each akp_b is given a +1 score (GP). When these scores are added, the total akp_b of the data (BGS) score is obtained. BGS score represents the cognitive modules that data and information includes, and the right knowledge.

$$BGS = \sum_{i=1}^n GP_i \quad (1)$$

GP = +1 and n is the total akp number of data

Experimental data are divided into its akp_b and compared to the akp_b of theoretical data. If each akp_b of experimental and theoretical data is semantically the same or similar, a +1 score (+PS) is added to the akp_b of experimental data. These +PS scores are added, and the akp_b score of experimental data (P) is obtained. The P point represents the cognitive modules and right knowledge in the data.

$$P = \sum_{i=1}^r +PS_i \quad (2)$$

+PS= +1 and r; total number of akp_b in experimental data ($r \leq n$)

Like knowledge calculations akp_b , in calculations of success, the result data are scored. Each akp_b is given a +1 score (Cb). With the sum of akp_b results that should be CB is calculated with the sum of existing akp_b scores, GS is calculated. CB scores represent the expected success, whereas GS scores represent the existing success or akp_b of CB, and GS represents the cognitive modules and success.

$$CB = \sum_{i=1}^n Cb_i \quad (3)$$

$Cb = +1$ and n is the total akp_b number of the result data

$$GS = \sum_{i=1}^r Cb_i \quad (4)$$

r ; is the total akp_b number in the result of the experimental data ($r \leq n$)

Classical level calculation

In VDOİHİ statistics, the division of the sum of same type scores (positive, negative, positive in negative, zero, and irrelevant) of experimental data by the sum of same type theoretical data is called "level." In the assessment and evaluation, the equivalence of levels in the system is mostly used. In this case, the level score is multiplied by the system score (100, 10, 5, and 4 point grading system and so on), and the system equivalence of level is calculated.

$$\text{Level} = \text{existing scores/scores that should be} \quad (5)$$

In the calculations of the P and BGS scores, the possibility of the circumstance is not included. Calculations in which the possibility circumstances are not included will be called "classical" calculations. As both P and BGS scores represent "knowledge," dividing the P score by the BGS score (APS) represents "the level of knowledge." Therefore, the APS score will be called the "classical knowledge level." If the scoring and calculations are the same, the obtained score (ASS) represents the "success level." Therefore, the ASS score will be called the "classical success level."

$$\text{Classical knowledge level} = P/BGS = APS \quad (6)$$

$$\text{Classical success level} = GS/CB = ASS \quad (7)$$

This calculation system will be called the "classical level calculation." This definition of the classical calculation and the details of the formulas are explained in the study of Yılmaz (2011) and Yılmaz and Yalçın (2011). These definition and formulas will be used in the calculations of combinations and information.

Assessment-evaluation relation

If the evaluation is done for equal scoring (probability), the ASP score is multiplied by the system score to obtain the system equivalent of classical knowledge level. The

classical success level, however, is calculated by multiplying the ASS by the system score. For instance in a 100 point grading system, if we want to obtain classical knowledge and success levels,

$$100 \text{ point grading system knowledge level} = APS.100 \quad (8)$$

$$100 \text{ point grading system success level} = ASS.100 \quad (9)$$

The classical calculation technique depends on comparing the expected akp and the akp "that should be the cognitive module." Therefore, in classical calculation, the "sub unit" does not pay attention to the possible circumstances of the data. This technique provides proof about cognitive functions but it does not deliver sufficient evidence of whether knowledge is a product of the thought that is created by the understanding processes or a product of cognitive automatism. In other words, the solely classical technique does not provide enough proof about whether inference is a product of thinking or deciding. When possibility circumstances are included, adequate proof is obtained. In order to determine whether knowledge is a product of thinking and deciding, combination and/or information theories should be used in evaluation-assessment. This proof also helps determine the understanding process or cognitive automatism.

Combination calculation

Terminology: Case (n), concerns the circumstances that include a possibility that should take place in data. Existing (chosen) cases will be called as "r." In VDOİHİ statistics, the case is akp . For knowledge, the akp_b that exists in the data (total score P), is equal to "r" ($r = P$). The expected Akp_b (total score GS) equals "n" ($n = BGS$). For success, the akp_b that exist in the data (total score GS) equals to "r" ($r = GS$). The expected Akp_b (total score CB) equals "n" ($n = CB$). In this case, "case" is the akp_b of the data, and it does not include the possibility circumstances of akp_b .

Possibility ($Pos(m)$), concerns the circumstances of a case. For instance, the circumstances of a coin are heads and tails, and its numerical value is $Pos(m) = 2$. In VDOİHİ statistics, akp can be given -1, 0, +1, and other scores, and these scores represent the circumstances of akp . Determining the possibility circumstances of a case is a product of thinking. Choosing (making the right choice) between the cases is related to "decision-making." Inference is the sample determined by thinking and deciding (cluster created with P possibilities). Probability ($Pro(A)$) is the rate of actualization. For a coin $Pro(A) = 1/2$.

$$Pro(A) = M_A / M \quad (10)$$

$$M_A = \sum_{i=1}^a 1_i \quad \text{and} \quad a \leq M \tag{11}$$

Number of samples (M) is the number of possibility distributions of a case or sum of case combination.

$$M = m^n = \sum_{i=0}^n \binom{n}{i} = \sum_{i=0}^n n! / (i! (n - i)!) \tag{12}$$

Assessment and evaluation relation: When the possibility circumstances of the akp of the data are determined (Pos(akp)), all cognitive modules and sub units that are necessary for cognitive function operations are determined (akp and Pos(akp)). Pos and Pro ensures all sub units of data to be included in the assessment-evaluation. Therefore, knowledge, thinking and cognitive functions are identified by pos and pro.

Combination knowledge and success calculations: In combination calculations, Pos(akp) cases of akp are included in the calculations. To achieve this, the Pos(akp)s of each akp is defined. In this study, the akp is defined and calculated based on two possible (Pos(akp) = 2) and equal Pro(akp) = 1/2 circumstances. Knowledge and success are calculated for certainty, certainty situations, total certainty, and (non)deficient akp. In these calculations, combination formulas are used. The combination definitions and formulas that are employed for knowledge will also be used for success.

Combination and certainty situations (BD_B^K) of akp_B are the samples of last akp_B values of knowledge (samples created by Pos(akp)s). Score is calculated by the combination of "r" of the circumstance,

$$BD_B^K = \binom{n}{r} = n! / (r! (n - r)!) \tag{13}$$

Pro of certainty situation is

$$\text{Pro}(BD_B^K) = BD_B^K / M \tag{14}$$

Combination certainty (B_B^K) of akp_B is the sample created by Pos(akp) until the last akp_B of knowledge,

$$B_B^K = \sum_{i=0}^{r-1} \binom{n}{i} = \sum_{i=0}^{r-1} n! / (i! (n - i)!) \tag{15}$$

$$\text{Pro}(B_B^K) = B_B^K / M \tag{16}$$

Total combination certainty (TB_B^K) of akp_B are the samples of certainty and certainty situations. The score is the sum of certainty and certainty situations,

$$TB_B^K = B_B^K + BD_B^K \tag{17}$$

$$\text{Pro}(TB_B^K) = TB_B^K / M \tag{18}$$

Deficient combinations (E_B^K) of akp_B are the samples created by the Pos (akp)s of akp_B that do not exist in the data and are calculated by extracting TB_B^K from the total combinations of a case.

$$E_B^K = OG_B^K - TB_B^K \tag{19}$$

$$\text{Pro}(E_B^K) = E_B^K / M \tag{20}$$

Akp_B combination that should be (OG_B^K) is the number of samples and calculated by the sum of combination.

$$OG_B^K = M = m^n = \sum_{i=0}^n \binom{n}{i} \tag{21}$$

$$\text{Pro}(OG_B^K) = OG_B^K / M = 1 \tag{22}$$

Combination level calculations: As in in classical calculations, the level is calculated by the ratio of certainty and total combination. In this study, the sampling ratio of total certainty will be used in level calculations. As the akp represents knowledge and success, the ratio calculations for knowledge give the knowledge level, and the ratio calculations for success give the success level.

Combination knowledge level (APS^K) is the division of certainty scores in knowledge by OG_B^K. As this study only deals with the division of TB_B^K by OG_B^K,

$$APS^K \equiv \text{Pro}(APS^K) = TB_B^K / OG_B^K \equiv TB_B^K / M \tag{23}$$

In this case , pro (APS^K) equals to pro(TB_B^K) . Combination success level (ASS^K)

In this study, the success level is the division of total certainty score in the success (TB_b^K) by the success combination that should be (OG_b^K),

$$TB_b^K = \sum_{i=0}^r \binom{n}{i} \tag{24}$$

$$\text{Pro}(TB_b^K) = TB_b^K / OG_b^K = TB_b^K / m^n \tag{25}$$

n, total akp_b scores of theoretical result data (n = CB). r,

total akp_b scores of experimental result data ($r=GS$) and $Pos(m)=2$

$$ASS^K \equiv \text{Pro}(ASS^K) = TB_b^K / OG_b^K$$

In this case, $\text{Pro}(ASS^K)$ equals to $\text{Pro}(TB_b^K)$

Relation of evaluation-assessment: As all possible sub units of data are included in combination calculations, the results reveal more proof about both cognitive functions and whether knowledge is a product of understanding process or cognitive automatism.

Information calculations: Operations are done by possibility circumstances of data (akp and $Pos(akp)$) in information calculations. Definitions made for knowledge, success and level in combination calculations will be used in H function calculations in information theories. Both calculations (combination and information) will be done for the $m=2$ circumstance of possibility. In this case, "entropy" or "information content" of data is calculated by,

$$H(x) = - \sum_{i=1}^M P(i) \log_2 P(i) \tag{27}$$

Equation

$$P(i) = \frac{1}{M} \tag{28}$$

$$H(x) = - M_A \left(\frac{1}{M} \right) \log_2 \left(\frac{1}{M} \right) = - M_A \left(\frac{1}{M} \right) \log_2 \left(\frac{1}{2^n} \right) = \tag{29}$$

The unit of $H(x)$ is "bit." The more bit (information content) means the more uncertainty of the circumstance.

Information calculations for akp : Information definitions and formulas made for knowledge will be used for success, as well.

akp_B information certainty situation (BD_B^E): It is the information content of possibility distribution of r^{th} circumstance or information content of combination of r^{th} circumstance.

$$H(BD_B^E) = - (BD_B^K / M) \log_2 (1/M) = - (\text{Pro}(BD_B^K)) \log_2 (2^{1/2^m}) = \text{Pro}(BD_B^K).BGS \tag{30}$$

akp_B information certainty (B_B^E): It is the information content of possibility distribution until r^{th} circumstance or information content of sum of combinations until r^{th} circumstance.

$$H(B_B^E) = \text{Pro}(B_B^K).BGS \tag{31}$$

akp_B total information certainty (TB_B^E)

It is the information content of possibility distribution including the r^{th} circumstance or information content of sum of combinations including the r^{th} circumstance.

$$H(TB_B^E) = \text{Pro}(TB_B^K).BGS \tag{32}$$

akp_B deficient information (E_B^E)

It is the information content of possible circumstances of akp that does not exist in the data.

$$H(E_B^E) = \text{Pro}(E_B^K).BGS \tag{33}$$

akp_B Information that should be (OG_B^E): It is the information content of cases (data).

$$H(OG_B^E) = \text{Pro}(OG_B^K).BGS = BGS \tag{34}$$

Information level calculations

Just like in classical and combination calculations level is calculated by the ratio of certainty and $H(OG_B^E)$.

Information knowledge level (APS^E): Knowledge level is the division of certainty scores in knowledge by $H(OG_B^E)$.

As this study only deals with the division of $H(TB_B^E)$ by $H(OG_B^E)$,

$$APS^E = H(TB_B^E) / H(OG_B^E) = \text{Pro}(TB_B^K) \equiv TB_B^K / M = APS^K \tag{35}$$

In this case, the combination and information levels are equal to each other, and they will be represented as $APS^{K,E}$.

Information success level (ASS^E): If the operations done in information knowledge level are done for success level, it is obtained that ASS^E is equal to ASS^K and therefore will be shown as $ASS^{K,E}$.

Evaluation-assessment relation

As each possible sub unit of data is included in the calculations, as in those of combination, the results both give sufficient proof about cognitive functions and about whether knowledge is a product of a thought of the understanding processes or cognitive automatism. It also characterizes the uncertainty of the data (the expected

and actual). Entropy and energy calculations can be done by the “bit” value obtained from such evaluation-assessment. For instance, by using the joule value, the energy that has been spent and that should be spent by a biological bit can be calculated.

General evaluation-assessment relation

By using akp and $Pos(akp)$ s with the classical, combination, and information theories of the VDOIHI technique, knowledge, success, and the knowledge success levels can be calculated. The combination and information *levels* are equal to each other. However, the combination and information, knowledge and success values are different from each other. Moreover, classical values are different from the combination and information values. Their meanings become different for evaluation-assessment. The aim of the valuation-assessment can determine which calculations should be used.

In the VDOIHI technique, the variables of the data are determined by the aim of the evaluation-assessment. For instance, if evaluation-assessment is performed by problem solving techniques, the given-asked of problem solving, free-body diagrams, definitions, formulas, operations, and separation techniques are considered as variables. Operations are carried out separately based on these variables. It is important to determine the variables that affect thinking in order to state whether knowledge or the knowledge level occurs as a result of the understanding processes or cognitive automatism. Subsequently, the knowledge level can be determined by taking all the sub units of these variables into consideration. After all, these detections are complete; by comparing the knowledge and success levels of variables, it is possible to determine if knowledge is a product of thinking. If a statistical relation is built between knowledge and success levels, it can be stated that knowledge is a product of thinking as a result of understanding processes. If a statistical relation is not built, knowledge is a product of cognitive automatism and can be called “memorization” knowledge.

METHODOLOGY

This is a case study. The data of this study was collected by a single assessment tool, which consisted of 11 open-ended procedural knowledge problems that were related 2nd term physics lessons in electricity. The assessment tool was applied to 44 prospective science teachers, one week after teaching this subject. The prospective teachers knew how to solve a problem by using problem solving techniques (given-asked, free-body diagram, “SCD,” definition, formula, and operation).

Problem solving techniques were the *independent* variables of this study. Knowledge and knowledge levels will be defined by these independent variables. The result obtained by problem solving is the dependent variable. The success and success levels will be defined by these dependent variables. Classical, combination, and information theories will be used in definitions. In

scoring data and classical calculations, the VDOIHI combined staging technique, which is developed for 2-possibility circumstances, will be used (Yılmaz, 2011; Yılmaz and Yalçın2011).

In this statistics technique, the variable is divided into its significant smallest pieces (akp). The akp of experimental data is compared to the akp of theoretical data and given -1, 0 and +1 scores. Based on the scores +, -, or 0 for experimental data, different stages are defined. For each defined stage, calculations are performed only if a stage has its own score.

This reduces the possibility of stages down to 2, which will be accepted as an equal probability. In this study, calculations will be executed based on the + values of the akp . With the sum of akp_B scores of independent variables of theoretical data “BGS” scores will be calculated. With the sum of + akp_B scores of independent variables of experimental data, the “P” score will be calculated. With the sum of + akp_B scores of dependent variables of theoretical data, “CB” score will be calculated. With the sum of + akp_B scores of dependent variables of experimental data, “GS” score will be calculated. These calculations will be called “classical calculations”.

In this study, the akp will be accepted as the cognitive modules of data. Therefore, “understanding” can be associated with the akp . The akp and $Pos(akp)$ s ($akp+Pos(akp)$) will be accepted as the sub units of data. In this case, thinking or knowledge can be associated with $akp+Pos(akp)$ s. In the classical, combination and information calculations, definitions and formula given in the theory part of this study will be used. The calculations for dependent and independent variables will be done separately. The P, BGS, GS, and CB scores of variables will be calculated by averages. The first scores (P, BGS, GS, and CB) of each variable of specific data (data obtained from one prospective teacher) in 11 questions will be determined. The same operations will be done for all data. Scores of the same question of the data will be added and averaged. Scores calculated for each question will be added and then divided by the number of questions to obtain result scores.

The calculated scores will be transformed into “whole numbers” by rounding up, in order to use them in combination and information calculations. With this whole number, value combination and information combinations will be done. *Packaged software program* developed for VDOIHI technique will be used in calculations. The data will be analyzed by the knowledge, success, and knowledge and success level scores obtained via classical, combination, and information calculations of variables in problem solving of procedural knowledge. The analysis done by these scores will include the cognitive functions, inference, thinking, and decision making situations of prospective science teachers.

RESULTS

The data were collected through the solutions of procedural knowledge problems which were about the electricity subjects of a science physics lesson. By applying the VDOIHI technique to the data, the results of cognitive functions were obtained. Electricity subjects were preferred, since they include more than one law, and the applications of these laws are suitable to define cognitive functions and consist of scientific knowledge. Procedural knowledge was preferred as it is the first step in understanding.

Moreover, as the rights and wrongs in procedural knowledge will affect all cognitive function stages, cognitive function situations were determined by three different theories-- based on knowledge, success, and knowledge level and success levels--in order to make the

Table 1. Classical, combination and information knowledge values in independent variables.

Variable	Level/ variable*	Given- asked	Free-body diagram	Definition	Formulas	Operations	Variables of average
Classical	P	2	2	5	2	7	4
	BGS	11	6	18	6	20	12
Combination	B_B^K	12	7	4048	7	60460	299
	BD_B^K	55	15	8568	15	77520	495
	TB_B^K	67	22	12616	22	137980	794
	E_B^K	1981	42	249528	42	910596	3302
	OG_B^K	2048	64	262144	64	1048576	4096
Information (bit)	B_B^E	0.06	0.66	0.28	0.66	1.15	0.88
	BD_B^E	0.30	1.41	0.59	1.41	1.48	1.45
	TB_B^E	0.36	2.06	0.87	2.06	2.63	2.33
	E_B^E	10.64	3.94	17.13	3.94	17.37	9.67
	OG_B^E	11	6	18	6	20	12

right detection and solution suggestions. The VDOIHI technique, which separates data into its akps, provides an objective logical simplicity of measurement for knowledge and success.

In this study, independent variables that affect problem solving are given-asked, SCD, definition, formula, and operation variables. Knowledge in the independent variables is defined by three different theories, which are given in Table 1. In Table 1, the average of five variables is given in the last column. The values in the BGS, OG_B^K , and OG_B^E lines show the akp_B values that should be in the independent variables, and the other lines show the existing akp_B values of prospective science teachers. BD_B^K and BD_B^E are the value of the last unascertained akp_B (the last P). B_B^K and B_B^E are the value of conclusive akp_B ("P-1") and can be interpreted as highly permanent learned knowledge. TB_B^K and TB_B^E are the expected akp_B value in the akp_B . E_B^K and E_B^E is the value of insufficient akp_B (BGS-P) in the expected akp_B .

As the akp of independent variables represents the smallest significant pieces of knowledge, the values in table 1 will be interpreted as knowledge values. Knowledge was determined by three different theories for five independent variables, and it was concluded that the prospective teachers' knowledge certainty (knowledge "P," certainty state. The meanings of the variables can be found in Mathematics-statistics theory section.

"Unascertained knowledge," certainty "conclusive knowledge," and total certainty "existing knowledge) were significantly lower than what it should be. It was deduced that the conclusive knowledge calculated for independent variables via the combination and information theories

was higher than high the permanent knowledge.

This result shows that, prospective teachers will have difficulty in declaring procedural knowledge or solving procedural knowledge questions. The fact that the deficient knowledge level was higher than the knowledge level in five different variables reveals that the prospective teachers have learning and educational problems. The difference (deficient knowledge) between the knowledge levels that should exist and the knowledge level in five independent variables provides information about must be addressed in teaching and education.

The fact that the deficient knowledge levels of the last column of Table 1 are almost four times bigger than the average of knowledge levels proves the necessity of reform in these areas. Certainty, certainty situation, total certainty, and deficient knowledge situations calculated via combination and information theories cannot be calculated via classical theory because $Pos(akp)s$ must be included for these calculations.

The difference of combination and information theories for assessment-evaluation is that in information theories, H represents the uncertainty of a situation; however, combination theories allow us to define the uncertainty of information theories as certainty, certainty situation, total certainty, deficient akp (knowledge), or akp that should be. The results calculated via combination and information theories are equal to each other. As in knowledge calculations, the values obtained from the calculations scoring akp_b of the result data (dependent variable) are given in Table 2. The akp_b of dependent variables represents the smallest significant piece of success; the values in Table 2 will be interpreted as the success value.

The success of prospective teachers was found to be closer to the expected success, based on knowledge

Table 2. Classical, combination and information success level of dependent variable.

Variable	Level/variable*	Akp/ Bit
Classical	GS	6
	CB	11
Combination	B_b^K	1024
	BD_b^K	462
	TB_b^K	1486
	E_b^K	562
	OG_b^K	2048
Information (bit)	B_b^E	5.50
	BD_b^E	2.48
	TB_b^E	7.98
	E_b^E	3.02
	OG_b^E	11

* The meanings of the variables can be found in mathematics-statistics theory section.

levels. This shows that prospective teachers think in a result-oriented way and that they know the problem solving techniques well. The fact that conclusive success is higher than unascertained success demonstrates that success is repeatable.

That the existing success level is higher than the deficient success level proves that formal education process is supporting success. The fact that existing success is closer to expected success than to knowledge levels shows that prospective teachers have knowledge problems.

Knowledge and success levels based on the calculations of values given in Tables 1 and 2 are shown in Table 3. Here, APS levels are knowledge levels. The classical knowledge level has been calculated by dividing the P value in Table 1 by the BGS value. The combination and information knowledge levels have been calculated by dividing the existing knowledge ($TB_b^{K,E}$) by the expected knowledge. ASS values in Table 3 represent the success level. Classical success level has been calculated by dividing the GS level in Table 2 by the CB level. The combination and information success levels have been calculated by dividing the existing success ($TB_b^{K,E}$) by the expected success. Though the same assessment tool and the same akp values have been used, classical and combination-information knowledge and success levels are rather different from one another (except from the knowledge level of SCD and the formula variable).

However, in all levels with the calculations by three different theories, the knowledge levels are lower than success levels. These results prove that prospective

teachers think in a result-oriented way or do not know problem solving techniques; it is also possible that the knowledge level of the independent operation variable is close to success level, which would prove that the success of prospective teachers might be the result of correct operations. That the knowledge level of the SCD and formula variables is close to success level supports this conclusion. The knowledge level of this variable, which is determined by the SCD drawings of correct formula or formulas, shows that the success level value can be obtained through correct operations.

However, the difference between the knowledge level of the independent operation level, which is obtained via combination-information calculations, and the success level is quite high, and they are not at the closest levels. The closest values to success level are the other variables that *may* affect the success. In classical calculation, the knowledge levels of independent variable SCD and formula. This proves that prospective teachers arrived at their results with correct formulas and through correct mental processes. The difference between these two knowledge levels and the success level is almost two time higher and success level; its being as high as 0,73 shows that prospective teachers have reasoned well. The meanings of the variables can be found in Mathematics-statistics theory section.

In two different level calculations in which the cognitive modules and sub units of a problem are defined and the need for a structural model of problem solving is determined for the independent given-asked variable, the APS and $APS^{K,E}$ levels are much lower than those of the ASS and $ASS^{K,E}$. This result proves that prospective teachers have completed problem solving without employing *understanding processes* and procedures. As a result, it can be deduced that the

ASS and $ASS^{K,E}$ values of the independent operation variable decreases. One of the structural models of problem solving is that the solution is done by the independent variable of this study. The fact that although prospective teachers know this model and that their knowledge level is low reveals that they inadequately structure models. The second structural model can be used in problem solving with the independent SCD variable. The knowledge level of this variable is equal to the average knowledge level of the five variable values (Table 3, last column) in classical calculations and is higher than the average values in the combination-information calculations; these results show that the prospective teacher preparation can be improved. The fact that the knowledge level was lower than the success level demonstrates that prospective teachers have difficulty in the analysis of a problem. However, the fact that success level are higher than the knowledge level proves that the problem synthesis and prediction states of prospective teachers are better than their understanding, modeling, and analysis states.

Since the knowledge levels of prospective teachers are

Table 3. Classical, combination and information knowledge and the success levels of dependent and independent variables.

Variable	Level/ variable*	Given-asked	Free-body diagram	Definition	Formulas	Operations	Variables of average	
Classical	APS	-	0.18	0.33	0.28	0.33	0.35	0.33
	ASS	0.54	-	-	-	-	-	-
	APS ^{K,E}	-	0.03	0.34	0.05	0.34	0.13	0.19
Combination and information	ASS ^{K,E}	0.73	-	-	-	-	-	-

lower than their success levels, it is clear that their inference and decision-making is relatively good. However, the classical value of the success level is 0.54 (%54), although the classical value of knowledge level of independent operation variable, which determines a decision, is 0.35 (%35); this result shows the uncertainty in the decision-making processes. The fact that combination-information value of the success level is 0.73, while the combination-information knowledge level of the operation variable is 0.13 reveals that uncertainty in the decision making-process has increased. The combination-information success level value of 0.73 and the classical success level value of 0.54 prove that inference is better in combination-information calculations.

Since thinking is about dividing data into its sub units and building semantic coordination among these units, using logic rules, mental mutation, and the recombination of all these abilities, the division of data into sub units is the first step. This is achieved by determining the *akp* and *Pos(skp)*s via *VDOİHI* technique. Since in problem solving technique sub units are determined in the given-asked variable, knowledge level of this variable provides information about how thinking emerges. The knowledge level of this variable is 0.18 in classical calculations and 0.03 in combination-information calculations, which demonstrates that prospective teachers do not employing *understanding processes*. In this case, the other

variables might be the result of *cognitive automatism*, which is always ready for knowledge and the success level actions and occurs when the circumstances are ready.

In both level calculation techniques, the knowledge level of prospective teachers is low for the cognitive domain structure, which reveals that procedural knowledge is below a significant level or with significant features. According to classical calculations, the success level value (ASS=0.54) indicates that the teachers can solve procedural knowledge problems about electricity within the scope of what they have learned; according to the knowledge level values (average APS 0.33), they can apply what they have learned with faults. According to combination-information success level values, they can solve procedural knowledge problems about electricity well within the scope of what they have learned (ASS^{K,E}=0.73), whereas according to their knowledge level values they cannot apply what they have learned (average APS^{K,E} =0,19). In this case, the prospective teachers include those who have learned well or less well, but do not possess firm knowledge.

DISCUSSION AND CONCLUSION

The *VDOİHI* technique was applied to the sample group of this study via problem solving techniques about procedural knowledge of Newton's law of

motion and the results were low (Yılmaz, 2011; Yılmaz and Yalçın, 2012b), as in this study.

Thus, prospective science teachers have procedural knowledge problems for cognitive domain structures. Moreover, in the same sample group, classical knowledge, he knowledge levels, and the success level obtained with for problem solving techniques about declarative subjects on Newton's law of motion was low (Yılmaz, 2011; Yılmaz and Yalçın, 2012a, 2012c); consequently, procedural knowledge problems in cognitive domain structure cause declarative knowledge problems. The fact that prospective teachers use cognitive automatism in problem solving might be a cause of the procedural and declarative knowledge problems. In a study, Heller et al. (2012) state that item scores might be affected by selected-responses. Selected-responses are a product of cognitive automatism. Prospective teachers may use cognitive automatism because of selected-responses.

Mathematical logic structure of scientific knowledge might be effective in degrading a single meaning with minimum terms, including maximum data in the spectrum obtained by cognitive modules from data through the understanding processes. In the analysis of the sample group of this study, mathematical logic, classical knowledge, and success levels about electricity and magnetism were lower than the classical values of this study (Yılmaz, 2012, 2014). The fact that mathematical

knowledge and success levels are low might be the reason why prospective teachers *do not use* their understanding processes. Consequently, in-class practices of teachers and teacher professional development affect student learning (Garet et al., 2001; McCutchen et al., 2002; Roth et al., 2011). Problems generated by teachers might cause students to employ cognitive automatism instead of the understanding processes.

The result that the knowledge, success, the knowledge level, and the success level of this study are low might be related both to the learning of prospective teachers and also to their teaching. Studies show that student success is founded on teacher content knowledge, skills, and practices (Desimone, 2009; Heller et al, 2012; Hill et al., 2008; Scher and O'Reilly, 2009; Wilson and Berne, 1999). Science content knowledge can increase skills and practices (Cohen, 1990; Desimone, 2009; Heller et al, 2012). Students reflect their knowledge levels in biology class success (Wadouh et al, 2014).

However, this study demonstrates a relation between the knowledge and success levels of students; the fact that their knowledge levels are lower than their success levels proves that their knowledge level is not well reflected in their success levels, a result which conforms to those of earlier studies (Yılmaz, 2012, 2014; Yılmaz and Yalçın, 2012a, 2012b, 2012c). Moreover a significant correlation has been found between student interest in electricity and student achievement in electricity (Sencar and Eryılmaz, 2004). Low success might be a result low student interest. Motivation can be used in knowledge level mechanisms (Di Sessa, 2014). The low level of knowledge might be a result of low teacher motivation.

In literature on the symbolic level, the organization of a knowledge base focuses on how a user expresses information in a representation language. Though the knowledge level can be described as the symbolic level (Newell, 1982, 1993; Stephens and Chen, 1996), it is not possible to say that human brain thinks in symbols. They think in "words or significant pieces (akp)" instead of symbols. The symbol level description shows how knowledge level behavior is attained (Newell, 1993). In this study, classical, combination, and information calculations performed with akp reveals that the knowledge and symbol levels can be expressed as a single level.

In prospective teacher problem solving about the procedural knowledge subjects of electricity, knowledge and success levels can be improved. However, increasing continuity and productivity is related to increasing the knowledge level of independent variables of the research. These improvements can help prospective teacher scientific knowledge become a product of thought based on cognition. Knowledge as a product of thinking affects success and success levels positively.

The prospective teachers' use of the understanding processes is determined by their solutions for open-ended questions with problem solving techniques. In order to

obtain more information whether "understanding process," which means degrading whole spectrum that emerges through thinking or cognitive automatism into a single meaning with possible minimum terms and maximum meaning has occurred or not, the solution for the question can be given and the question is asked or similar techniques can be used. If the Pos(akp)s of cognitive modules are included in assessment-evaluation, results obtained for cognitive functions and thinking might differ, as Table 1, Table 2 and Table 3.

Classical calculations are essential when quantity is important, whereas combination or information calculations come into play when quality is important. If control gains in important in the assessment-evaluation, they should be calculated, such as with energy levels. If learning is not accidental, the energy that is required for learning is determined and should be supplied. Energy can be determined through information calculations.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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