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Application of Learning Theories in Curriculum Development and Implementation of the MLT Diploma Programme in Uganda

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Authors' contributions

This work was a joint effort between the two authors in design, data collection, and analysis as well as writing the manuscript.

Original Research Article

ABSTRACT

Learning theories play a significant role in curriculum development and implementation. This study evaluated whether and how various relevant and appropriate learning theories were applied in the curriculum design process of the Medical Laboratory Technology (MLT) diploma programme in Uganda. The evaluation entailed the analysis of curriculum documents using a checklist. The checklist comprised of statements depicting the application of specific learning theories. The study also gathered data through questionnaires administered to respondents who included: learners, educators, and clinical supervisors. The results of the study revealed that different learning theories informed the curriculum design process of the MLT diploma programme and promoted the enhancement of appropriate learning outcomes. According to responses from respondents, use of learning theories to inform the process of curriculum development was rated very high. The conclusion of the study is that relevant and appropriate learning theories need to be considered during curriculum development of any programme.

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1. INTRODUCTION

Learning theories are central in curriculum development and implementation [1]. Learning theories attempt to describe how individuals learn and retain any given information and underlying learning principles [2,3]. Different learning theories provide varying expositions about learning and "specify the link between what is learned and the conditions under which learning occurs" [4]. The theories also inform the process of curriculum development and implementation. Different learning theories lead to different orientations and outcomes of curriculum implementation. The various curriculum implementation strategies and methods therefore underpin different learning theories. Hence, learning theories act as a framework to guide the decisions made during curriculum design and implementation. It is important to evaluate how different learning theories informed the curriculum design and implementation process. Bleakley, Bligh and Brown [3] explain that "We need theory of learning that captures this dynamism (learning through time as well as in space), interaction and relation of elements (complexity), collectivity, uncertainty, and systematic connection between personal agency, social context, artefacts mediating learning, rules of practice and the development of roles and identities"

As Bleakley and others have rightfully indicated that medical education is becoming more and more complex, application of relevant and appropriate learning theories in the design and implementation of health sciences education programmes is extremely vital. Indeed, "students in the professions should be learning bodies of knowledge that structure their practices. This learning shapes identities that are realized responsibly in communities of practice" [3]. A curriculum designed and implemented based on relevant learning theories should be able to guide the orientation of learners towards achieving the desired learning outcomes. It is therefore, necessary to ascertain whether the curriculum design and implementation processes are based on relevant and appropriate learning theories.

This study investigated how different learning theories were appliedduring the development and implementation of the MLT diploma curriculum in Uganda. The purpose of the study was to ascertain whether the applied learning theories were relevant to enhance adequate preparation of professional medical laboratory workers. This paper also attempts to evaluate how various learningtheories were applied in the development of the curriculum.

2. LITERATURE REVIEW

Learning theories provide a framework for curriculum foundation and areconcerned with the rules, which govern the construction, transfer and retention of knowledge. Learning theories offer insights into "what promotes learning effectiveness and how students learn". According to Gunderman [5] "theories of learning shape our educational practice".

Indeed "Learning requires ensuring transfer of knowledge and skills learned from the classroom situation to other situations in real life practice. It is therefore important to provide students with opportunities to practice and apply what s/he has learned theoretically in classrooms to other real life situations which are essential for an effective learning experience." Learning theories are based on principles that can guide effective teaching practice and facilitate deep versus surface learning" [2]. Breakley et al. [3] while discussing transfer of knowledge in health sciences education suggest that "good clinical teachers [should] know how to structure learning to maximize the opportunity for events to turn into experiences. Good clinical teachers do not simply 'facilitate learning,' but provide essential frameworks both to support learning and invite meanings for (and from) learning". Learning theories therefore, are central during curriculum development and implementation. Thus, in order to have the disposition that is required to be acquired by the learner, curriculum designers need to consider relevant and appropriate learning theories during curriculum design and implementation. This is important for the curriculum to be relevant in meeting the ever changing professional demands of contemporary medical workers.

Learning theories not only guide curriculum designers in making appropriate choices especially in the selection of teaching methods, but also strategies for assessment of learning outcomes [2]. What comes out clearly from our conceptualization of learning theories and the

processes of teaching and learning is represented in Fig. 1, which shows that application of a variety of learning theories in the curriculum design process may improve learning outcomes.
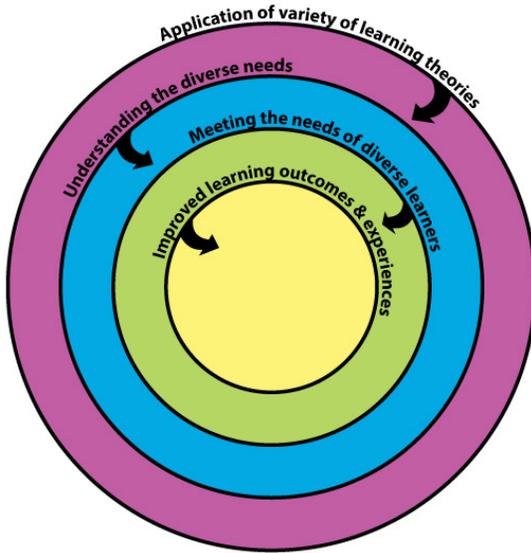
Fig. 1. Shows that applying a variety of learning theories leads to abetter understanding of learner's needs in diverse learning context

Explanation: Application of the relevant learning theories leads to understanding of the diverse learning needs of increasingly diverse learners. This may lead to the enrichment of the teaching and learning experiences thus improved learning outcomes. Given that knowledge of learner's needs enhances the use of appropriate instructional methods and proper assessment procedures [2].

The more learning theories are integrated in the curriculum design process, the more likely learners can be accommodated within the programme. Learners are diverse and their needs are equally diverse. It is important for curriculum designers to realise that needs of learners and learning contexts are dynamic and continuously change. Therefore, application of a variety of learning theories responds well to the diversity of learning needs for the diverse learners. As rightly presented by [5] that "Different learners learn best in different contexts and by different approaches, we can help our learners discover what works best for them by presenting them with different possibilities and

encouraging them to reflect on their learning experiences, and that some do best alone and others in small groups". Each learning theory "illuminates certain aspects of learning, and may provide valuable insights in certain situations". Bleakley et al. [3] explained that "No single learning theory has enough explanatory and predictive power to inform the range of practice found in medicine. However, the family of learning theories based on how an individual learns needs to be supplemented—or perhaps supplanted—to inform safe practice in dynamic and often high-risk contexts such as collaborative practice or team work". This may improve the authenticity of the programmes since "Our sense of the boundaries between the formal and informal curriculum, as well as the content of each, is powerfully shaped by our theoretical perspectives on learning" [5]. It also offers opportunities for the utilization of a variety of teaching and learning strategies to meet the diverse needs of learners and their diverse learning styles as explained in the various learning theories.

3. LEARNING THEORIES

The Stimulus Response Theories/Behaviourism emphasise that learning takes place in stimulus response patterns and that response is observable [6-9]. Learning leads to change in behaviour and the behaviour is sustained through reinforcement [7,8,10,11].

Skills development in training is mainly based on the behaviourism learning theories. It is based on the principles of programmed learning where mastering of related tasks in sequential manner lead to acquisition of skills. Programmed learning involves "managing human learning under controlled conditions" such as computer-aided learning. The materials to be learnt are presented in self-paced learning module, in small steps. The learner learns the materials in small doses and the learning– experience gives frequent feedback [12] –Programmed learning is the cornerstone of skills based education and training as practiced in health sciences education. In skills laboratories used in nursing, medical laboratory training and other health sciences, learners acquire skills in a programmed manner. The assessment of the acquisition of skills is based on the observation of patterns in performance of tasks which is within the context of the behaviourism learning

theories. Behaviourism is therefore fundamental in clinical work.

The Gestalt Field Theories assert that learning is the development of the thought processes, insights, perceptions, coding of information, recreation and reconstruction of the memory [6,7,11,13]. Learning is concerned with interpreting what has been perceived and is not observable [14]. Health Sciences Education and practice revolves around solving problems poised by individual patients and communities. The inclusion of learners' projects and case studies, and not exclusively studying facts in health sciences curricular is because of focusing on development of problem-solving ability which is within the context of the Gestalt Field Theories. This perspective affirms [5] that "Knowledge is not a collection of facts, but an array of habits by which to examine the world from multiple perspectives and the assessment based on problem solving and creativity becomes a kind of learning experience in itself". This is the basis of the Gestalt Field learning theories.

This perspective further focuses on developing deductive approaches in learners. The learner gets solutions to problems as a result of analysing and reflecting. This approach makes learners develop habits that lead them into acquiring a reflectivity process of inquiry that makes them analyse why practices and activities occur the way they occur. This is in agreement with the views of Bleakley et al. [3] that "Reflectivity offers a kind of ongoing quality assurance for practice in a monitory process through asking critically interrogative questions such as: why do we do it this way and not another way?". The study also considered Ausubel's theory of applying the cognitive structure and meaningful learning [15,16]. The theories emphasize learning relevant content and basing new learning on the already existing knowledge as opposed to rote learning.

The Cognitive Development Theories explain that learning is through interaction, dialogue and collaboration of learnt knowledge with previous knowledge and experience [17,18]. Out of these approaches learners acquire cognition of what they interact with. The learning can be mediated by experts, which leads to internalisation and development of independence by the learners [18,19]. Learning leads to development of conceptual frameworks rather than memorising facts [20]. It is believed that as one combines

new ideas with experience, new meaning is developed and communicated in a language [21].

Bleakley et al. [3] cited Schon's work (Schon, 1991) who introduced the idea of reflectionin community, where professionals learn collaboratively, by sharing good practices and offering peer support in democratic learning structures. Inter-professional training would illustrate this. *The practitioner allows himself to experience surprise, puzzlement, or confusion in a situation which he finds uncertain or unique. He reflects on the phenomenon before him, and on the prior understandings which have been implicit in his behaviour. He carries out an experiment which serves to generate both a new understanding of the phenomenon and a change in the situation* [22].

There are ***Cognitive processes involved in knowledge acquisition***. *Cognition* refers to processes that learners have to go through while acquiring knowledge [23]. According to Curzon (2004), cognition comes from a Latin word *cogito*, which means *to think*. Hawkins [24] defines cognition as knowing, perceiving or conceiving. Cognition involves acquisition, organization and application of knowledge. This entails the application of thinking, understanding and communicating about issues, which may also involve application of skills such as concept development, analysis, synthesis, model building, inferring, use of analogies and objective criticism [25]. Cognition therefore refers to non-observable changes reflected in the development of mental processes.

For individuals to acquire knowledge they must pass through a process of ***metacognition*** [26]. Metacognition involves individuals developing insights into their own cognitive abilities such as the memory and thinking process, and utilisation of these insights during the learning process. Metacognition also entails the ability to develop a personal learning strategy based on gaining of insights into his or her learning abilities, the demands of the learning tasks at hand, and variables that would influence learning. Learners' metacognitive abilities also enable them to monitor their own learning performance [25]. Taking an example of acquisition of procedural knowledge, Marzano and Pickering [27] explain the three phases through which it gets acquired. The three phases are the construct models, shape and internalisation. In the construct model phase the educator presents the model to be followed. In the shape phase the model gets

improved to make it more efficient to use. In the internalisation phase the learner gets involved in extensive practice and develops automaticity or fluency. Fig. 2 shows the three phases of Metacognition.
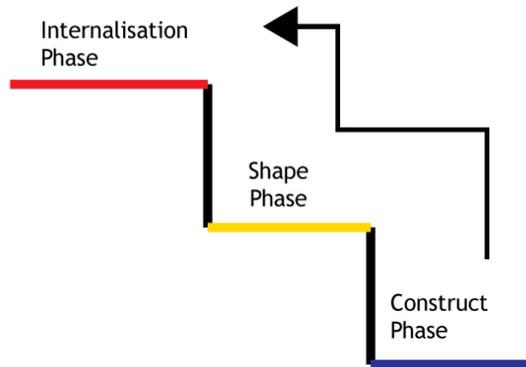
Fig. 2. The three phases of metacognition

"Ultimately, learning from experience requires metacognition—the ability to think about one's thinking and feeling and to predict what others are thinking. Metacognition is a critical feature of the emerging paradigm for clinical learning that shifts the emphasis in medical education from application of knowledge learned in the classroom to preparing students to effectively practice medicine and learn from their experiences." [28] Working in groups on a common health/clinical problem where each learner has opportunity to present and discuss their individual solutions to the problem in a group gives learners an opportunity to compare their thinking and feelings with that of their colleagues. This is one aspect that can foster metacognition among learners. This can be done in clinical areas and within communities where learners are made to give solutions to complex problems. In approaches that lead to development of metacognition among clinical and health sciences, learners need to be integrated in health sciences curricular implementation strategies. Knowledge of the three phases of metacognition should influence curriculum decisions. According to Quirk [28] "medical students can never learn their trade directly from classrooms, laboratory settings, simulations, and abstract knowledge, but must learn the core of their profession by practical knowing in work-based settings",

However, Mark Quirk [28] contends that "possession and use of metacognitive abilities

…is necessary for learning but not sufficient for developing clinical expertise". It is also important to note that clinical expertise comes as a result of developing a number of learning traits. Without metacognition, clinical experts could be missing this critical element of learning that makes experts to correctly relate and learn from each other. From this perspective metacognition is very important for academic and professional development and growth of learners and scholars.

"Metacognition can play an important role in clinical learning and practice" [28]. It makes learners think deeply about their choices and practices in their clinical work. Educators in clinical sciences need to appreciate that development of metacognition brings about critical thinking which is vital in decision making. "Metacognitive capabilities applied to social, cultural, and ethical concerns constitute the foundation of professionalism" [28]. Acquisition of metacognition makes experts consider the implication of their choices scientifically, professionally, ethically, socially and individually.

Teaching strategies should be organized in a way that helps learners to reflect on the ongoing changes in their cognitive development in the process of internalising the knowledge they have learnt from class [25]. Another related theory of learning called the ***Socio-cultural Learning Theory (Social Constructivism)*** is given by Vygotsky [29]. In this context learning can be looked at in the context of socio-cultural processes [18]. As such learners grow intellectually/cognitively through their interactions with other people during the process of performing routine duties, in which they get opportunities to practice their own knowledge, skills and understanding in real life situations [30]. This is in agreement with the views of Bleakley [3] to the effect that "Learning is intimately connected with social context and culture" and that "to divorce learning from these contexts is to both reduce and misunderstand the complexity of the learning experience."

Subsequently, learners acquire mental or cognitive development in terms of thinking, reasoning, logic and problem-solving skills. Numerous cognitive traits may also develop as a result of learners' collaborative efforts with other people around them [19,25,31]. In the MLT context, learners get the opportunity to interact

and collaborate with other people such as their own peers, clinical supervisors and educators who act as their mentors and role models. The opportunity to work collaboratively in small groups is a socially constructive approach of learning [12]. This is consistent with the collaborative theory of learning [2]. Thus, the curriculum implementation process needs to allow collaboration between learners and their clinical supervisors especially during their practicum sites experiences in clinical-related areas. This makes learners integrate the theoretical knowledge learnt in class and laboratories with practices in the real world of work. Bleakley et al. [3] concur that "Theory does not need to be marginalized where practical reasoning comes to displace the current dominant model of critical thinking in higher education for the profession. In medical education, practice (as work) can now be theorized eloquently through the new work-based learning theories".

Gravett and Henning [13] describe a learning approach known as dialogic **mediation**, where educators act as intermediaries between the learners and the new knowledge. The educator becomes a mediator between the current knowledge with the learner and the new knowledge is expected to be acquired by the learner. The educator mediates current knowledge by creating the appropriate learning contexts which encourage dialogue and mediation between the learner and the educator. Thus, this approach encourages learners to acquire new knowledge through dialogue and mediation [3]. "Mediation of learning by tools, instruments, codes, and languages, is complex. Personal cognition can be seen as situated in this extended cultural complex, rather than the complex itself being seen as an extension to personal cognition" [3]. This strategy leads to acquisition of self-directed learning attributes and experiences. As such curriculum design and implementation should adopt strategies that encourage dialogue and mediation between learners and educators.

Knowledge acquisition also involves empathy and integration of information /spatial awareness [32]. Spatial awareness makes learners develop capacity to humanely consider situations of other people, therefore ability to locate oneself properly within the surrounding diverse environment. It also involves discovering relationships and connections between ideas, concepts and situations (experiences).

"A community of practice is also a community of learners who gain meaning from learning" [3]. Thus, it may be necessary to study whether through interaction between medical teachers and their students does not bring to them increasing understanding of who a medical student is and their characteristics as a community of learners. This would be their sense of meaning as teachers in medical education. This is in agreement with [3] "clinical teachers gain a sense of meaning (rather than just satisfaction) from teaching, since meaning is linked to educational understanding" and therefore curriculum development should align the current teaching and learning with emerging clinical practices. Teaching and learning therefore should embrace modern reflective practices.

This is within the context of reflective thinking and learning. Reflective thinking and learning promotes experiential learning. Curriculum design and implementation therefore should aim at making learners acquire life-changing experiences in the process of learning through conceptualisation by making concrete observations and reflections [33].

There is yet another approach to learning which is based on understanding and working towards resolution of an identified problem. This approach is referred to as **problem-based learning** [34,35]. The approaches to teaching aim at fostering complementary aspects of theoretical and practical teaching and learning processes. This helps learners to easily remember the learnt knowledge and to apply it appropriately in solving real practical problems [36,37].

The complementary nature of the teaching and learning processes are at the centre of problem-based learning theories and is believed to encourage the development of autonomy in reasoning skills, and understanding of concepts among learners. This approach also makes learners acquire self-directed learning traits. This also in the context of situated learning and authentic activity [12] where learners get situated in real life situations where their learning activities and enquiries take place. This approach is referred to as situated learning theory. In this study it was revealed that the curriculum implementation strategies included taking students for clinical learning and community practice where the learning activities took place in real life situations. The Curriculum

development process therefore considered situation learning theories during the design of the curriculum.

According to Gunderman [5] instructionally, learners are not recipients of information, but active explorers of the field. Learning is an adventure, and missteps and failures are an inevitable and even desirable part of the learning process, as long as they are seized upon as learning opportunities". Curriculum strategies should be based on learning theories that emphasise active participation of learners. In health sciences education practical placements, learners' projects and enquiries need to be integrated in the curriculum implementation strategies,

The Phenomenological-hermeneutic Theories depict learning in the context of wholes and not fragments, and therefore integrated in various domains of knowledge [38] which refers to the integration of the acquired knowledge (cognitive), skills (psychomotor) and appropriate emotional orientation (affective). The learning environment should be free of restrictions and the teaching should aim at bridging the gap between what the learner knows and what s/he ought to know [7,39]. This way learning is seen as aiming at giving a complete picture or in context of wholes rather than fragmented knowledge. This agrees with Bleakley et al. [3] that "….a shift from multiprofessionalism (working with other professions) to interprofessionalism (working with and learning from and about other professions) and from multidisciplinary approaches to interdisciplinary and transdisciplinary approaches". This approach makes clinical related professionals understand and appreciate each other as members of one team. Learners get prepared to appreciate their future work counterparts in the process of achieving their professional education. This enhances teamwork and cooperation across professionals, which in turn improves delivery of healthcare services.

The Humanistic Theories of learning are based on the belief that man is a unique creature with varying capacities, self drive and a natural desire to learn [40]. Educators therefore need to help learners recoginise and achieve this natural desire of acquiring knowledge [41,42]. Learning therefore should aim at achieving this desire thus bringing about self-actualization. In this context, learners should be helped to gain control over their own education and take responsibility of their own learning. Learning should therefore be

focused on the interest of individual learners which leads to their self-fulfilment, increased self-esteem, development of intellect and creativity [6,8,43].

The Constructive Alignment Theories are yet another important area to consider during curriculum design. Constructive alignment refers to connectedness of the teaching and learning activities and assessment to learning objectives. During curriculum design, the designer should ensure that constructive alignment takes place. The alignment aims at establishing relationships between course philosophy and beliefs of the institution and the educators [44-46].

The Deconstruction Theories take learning to a level of critical analysis of the existing knowledge in order to discover new linkages and relationships [47]. The curriculum should therefore give room for learners to critique and question the existing knowledge and its authenticity. This helps them develop both analytical and enquiry skills. This makes learners develop relevant competences needed in the current clinical professional trends in the 21st Century.

Learning Theories of the 21st Century emphasise that education and therefore curriculum should focus on the development of skills required for the century [27,48,49]. Learning theories in critical thinking are based on the Greek philosophers' beliefs that truth is arrived at through critique and critical discussions of competing ideas [50]. It is further rooted in the reflective thinking theories of John Dewey [51], who insisted that reflective thinking is stimulated by a problem that desires decision making and thus a solution and judgment is therefore based on selecting and weighing of facts, suggestions as they appear and making decisions to whether 'the facts' are really facts. He emphasized integration of learners experience and reflection into teaching content. Watson and Glaser [52], Glaser [53] recommend that considerations should be given to attitude for thoughtful considerations of problems, knowing methods of logical enquiry, and how to logically weigh the accuracy of different kinds of evidences. Critical thinking has been emphasized in education philosophy and learning theories as being essential in problem solving, active learning, learner discipline, integration of subject disciplines and scientific enquiry [54-57].

Skills for the 21st century include critical and creative thinking, as well as collaboration. Critical thinking is an intellectual ability that makes learners recognise and develop arguments [58]. It is purposefully integrated, reason-based and goal-oriented thus makes learners to generate and use evidence to support arguments in all subject disciplines [25,59-62]. This ability leads learners in drawing convincing, justifiable and logical conclusions and using appropriate information in solving problems thus providing intellectual empowerment [63,64].

Creative thinking is considered to be the highest level of cognition [65]. Critical thinking is the ability of learners to generate new ideas, recognise new situations and application of appropriate new ideas in the new situations [66]. Being able to apply these new ideas correctly is in itself collaboration. Critical and creative thinking abilities get developed in learners when they get involved in performing problematic, independent and collaborative tasks which require reflection on numerous possibilities [67-70]. This enables the learner to develop habits, attitudes and dispositions that make them think skilfully when confronted with problems [71-75]. Collaboration should be integrated in curriculum implementation strategies in health sciences educational programmes. As noted by Bleakley et al. [3] health professionals need to be oriented on "the idea of reflection-in community, where professionals learn collaboratively, by sharing good practices and offering peer support in democratic learning structures".

Inter - professional training illustrates this phenomenon and should be part of curriculum implementation strategies especially in health sciences education where different cadres of health professionals collaboratively work closely with one another on activities that involve care for the health of human beings. Again this is in line with Bleakley et al. [3] who emphasize "….a shift from multi-professionalism (working with other professions) to inter-professionalism (working with and learning from, with and about other professions) and from multidisciplinary approaches to interdisciplinary and transdisciplinary approaches" [15,16].

The learning theories should be used in the design of curriculum aimed at developing learners' capacity in creative and critical thinking skills. This needs to be deliberately planned and clearly described in the curriculum as it does not

necessarily develop according to the age of learners but rather according to their preparedness [76]. This is likely to assist learners to develop capacity to generate and evaluate knowledge. It will also enhance their ability to understand and explain complex concepts and ideas. Learning theories should focus on the curriculum to emphasize practices like reading and writing culture which inculcate critical thinking and therefore problem solving skills [77]. The characteristics of critical thinking include ability to sequentially think productively, purposefully and intentionally. Developing such trends in learning enables learners develop learning styles that help them to steer easily through problems, challenges and new learning situations which are part of the required skill demands for the 21st century.

Active learning which engages the minds and the hands should be the focus of the strategies for curriculum implementation as evidenced to be viable by various studies [78]. Mugisha and Mugimu [79] explained how curriculum implementation strategies assisted learners to develop analytical skills, which is a component of critical thinking.

4. METHODOLOGY

The researchers evaluated whether relevant and appropriate curriculum learning theories were applied in the MLT diploma curriculum design and implementation. The study applied a qualitative research design involving a historical method [80]. The study also integrated some aspects of action research because one of the researchers was using the research results to inform adjustments in the implementation of the MLT curriculum. In developing the research method, the study was guided by the conceptual framework in Fig. 3.

Fig. 3 Clearly shows that if the curriculum is to be critically analysed, one should understand the learning theories that were applied during curriculum design and the decisions that were made in order to shape the curriculum structure. As such, the study further applied aspects of the grounded theory [81] where phenomonological approaches were applied in designing the strategy for getting information from learners and clinical supervisors.
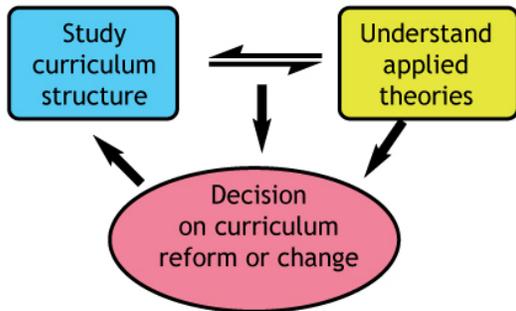
Fig. 3. Shows understanding curriculum structure and applied learning theories informs curriculum reform

The sampling of the study populations was done using accidental and random sampling methods as described by Robson [82-84]. While documents and clinical supervisors were sampled using accidental sampling approaches, the learners were sampled using simple random sampling methods. The study sample included 63 learners (64% of the learner study population), 30 supervisors (100% of the supervisors' study population). The documents used in the study included the official MLT curriculum, Health sector strategic plan (2006-2010), and the Education Sector strategic plan (2006-2010). These documents were obtained from the Ministries of Education and Health. The curriculum document was obtained from the administration of Uganda Institute of Allied Health and Management Science Mulago (UAIHMS).

Thus, the study utilized blended methods for data collection that included, checklists, survey questionnaires and official document analysis [85,86]. The research instruments used included a set of questionnaires administered to learners and clinical supervisors. The research methods and instruments used were the most appropriate based on the conceptual framework and current realities [86]. The checklists and survey questionnaires contained standard descriptions of the expected relationships between various learning theories and elements/contents of official curriculum documents in use. The instruments were developed focusing on issues which depict conformity with various learning theories adopted from literature relevant to curriculum development. Thus, the tools sought the views of respondents regarding the relevancy and appropriateness of various learning theories used in the process of MLT curriculum design

and development. Document analysis was done and also offered insights into whether curriculum design considered relevant and appropriate learning theories as antecedents, context and foundations of the MLT diploma programme. Document analysis entailed careful analysis of the curriculum documents alongside with strategic plans of both the Health and Education ministries. This was to investigate the relevance of curriculum content and strategies and their connection/linkage with appropriate learning theories. This was also used to evaluate the compliance of the curriculum design process in utilizing relevant learning theories. Furthermore, the researchers analysed the qualitative responses of learners and clinical supervisors contained in the checklists and questionnaires. The data was analysed using grounded theory approach [81]. The results are presented in Tables 1, 2 and 3.

5. RESULTS

The researchers analysed the content of the curriculum document and found out the following; Regarding learners' perceptions of the MLT Curriculum and application of learning theories, results show that 58 out of 63 (90%) learners agreed that there was compliance. The details of areas rated with respective learning theories implied are listed in Table 2.

The findings showed that 9 out of the 10 (90%) educators and 27 out of the 30(90%) clinical supervisors agreed that learning theories were applied during curriculum design and implementation. The details of the key areas rated with respective learning theories implied are listed in Table 3.

6. DISCUSSION

Curriculum design and development principles ideally require integration of learning theories and interests of the various stakeholders of a curriculum. This study evaluated whether and how various relevant and appropriate learning theories were applied in the curriculum design process of the Medical Laboratory Technology (MLT) diploma programme in Uganda. At least to our knowledge, there is no other study that has investigated the extent to which learning theories have informed the curriculum design and implementation processes at the MLT since its inception.

Table 1. Shows theories applied in MLT curriculum design

Theory	Key concepts identified in MLT curriculum documents
Stimulus response or behaviourism theory	• The procedure for measuring the progressive achievements of learners was in place. • Promotion of skills and experiences through experiments and laboratory procedures were planned for. • Laboratory attachment to enhance the practical experiences of learners was planned for in the programme.
Gestalt field theory	• Learners were encouraged to discover new ways of doing things as part of their own learning.
Cognitive development theory	• Learning through personal involvement of individual learners was planned for. • Plans for practicum attachment to enhance learners' interactions with real life clinical work sites was in place.
Phenomenological-hermeneutic theory	• Proper schedules for practicum attachment in clinical work site was in place. • There was emphasis on the use of real life examples in teaching. • Strategies were in place to encourage learners to participate in community activities related to MLT practice. • Curriculum content was based on real health needs identified in the Health Sector Strategic Plan (HSSP).
Deconstruction theory	Learners were allowed to participate in projects and to make their own conclusions.
Constructive alignment theory	• The structure of the MLT curriculum was complete and well organised . • The MLT curriculum had proper implementation guidelines. • MLT schedules were also linked to other clinical units i.e. MPS schedules. • The MLT programme shared resources, learning experiences, and facilities with other clinical related programmes of the institution. • The MLT curriculum programme had proper exit outcomes. • The outcomes indicated in the curriculum corresponded with routine operational procedures contained in the laboratory manuals. • Professional course content was aligned with the foundational courses. • The MLT curriculum was organised basing on the problem-centred and learner-centred approaches. • The MLT curriculum organization structure was progressive in nature. • Horizontal curriculum organization of content was emphasized. • Primary healthcare content had been integrated in the MLT Curriculum. • Relevant modern and international approaches in the teaching and clinical practice were incorporated in the MLT curriculum. • Institutional ethos of the implementing institution was considered during MLT curriculum design.
21st century learning theories	• The curriculum document strategies were found to be; Allowing learners to develop their experiences through practical clinical attachments where they participated in clinical work which led to active learning; • Practicing in clinical work developed professional skills and enhanced integration of subject disciplines among learners;

Theory	Key concepts identified in MLT curriculum documents
	• Assisted learners to engage in collaborative projects with colleagues where they were able to solve sets of problems;
	• The strategies encouraged learners to conduct their individual research projects, analyse results, generate new ideas, and draw their own conclusions.
	• Curriculum documents provided a frame work that gave a structure and context.

Table 2. Shows theories applied at MLT based on learners' perceptions

Theory	Key Concepts identified from learners' perceptions
Behaviourist; Humanistic	• Provisions that allowed learners to take a break and resume studies if the learner desired to do so were within the curriculum implementation guidelines. • Learners found that curriculum content was organised in a manner that made learning participatory and interesting.
Cognitive phenomenological-hermeneutic/ constructive alignment	• Schedules allowed learners to be placed for field attachment in clinical related sites. • Learners were able to identify exit outcomes within the curriculum document for the current MLT programme content. • Learners could easily identify curriculum content within the curriculum. • MLT Professional courses content followed the basic sciences (foundational) courses. • Learners felt curriculum content coverage was appropriate. • Learners felt that appropriate procedures for measuring/assessing their academic progressive achievements was in place.
Behaviourist; cognitive; 21stcentury	• The MLT diploma curriculum had curriculum schedules which included attachment of learners in clinical areas.
Phenomenological-hermeneutic	• The outcomes indicated in the curriculum corresponded with what is practiced in clinical laboratory. • The curriculum was organised basing on practical issues that made learning interesting.
Cognitive and 21stcentury learning theories	• Curriculum organization was progressive in nature.

Table 3. Shows theories applied at MLT based on clinical supervisors' perceptions

Theory	Key concepts identified from clinical supervisors' perceptions
Phenomenological-hermeneutic	• Primary health care content had been integrated in the Medical Laboratory Technology Curriculum. • Use of real life examples in teaching was recommended. • Learners were allowed to participate in community activities while conducting surveillance of diseases and blood donor recruitment. • Curriculum content was based on real health needs identified in the HSSP. • Relevant modern and international approaches in the teaching and practice of the MLT profession were incorporated in the curriculum. • Institutional ethos of the implementing institution was considered during curriculum design
Stimulus response and	• Gaining skills experience was planned to take place through

Theory	Key concepts identified from clinical supervisors' perceptions
21[st]century learning theories	conducting experiments and doing routine laboratory procedures. • Laboratory attachments of learners was planned to enhance the practical element of the programme.
Social cognition and 21[st]century learning theories	• Practicum attachment was provided for in the curriculum implementation schedule.
Phenomenological-hermeneutic, cognitive, stimulus response, deconstruction and 21[st]century theories	• Integrated approach in the teaching was recommended in the implementation strategy.
Phenomenological-hermeneutic and 21[st]century learning theories	• Learning was planned to take place through personal involvement of individual learners

Application of relevant learning theories turns out to be extremely important for setting up proper and effective curriculum design and implementation principles. Indeed to a larger extent, the success of the MLT diploma programme relied on the fact that diverse learning theories were appliedduring curriculum design and implementation. The application of diverse learning theories led to inculcation of deep learning processes among learners [2]. This was critical given that in health sciences' education generation of knowledge revolves around community health issues and practices of health professionals. The community health issues refers to the existing needs or health demands in the community, while practices of the professionals refers to the desired healthcare services the community requires from clinical professionals. In this vain, findings of this study eluded to the fact that acquisition of skills from the professional practitioner's point of view aimed at addressing existing societal needs as well as interests of learners, communities, clinical professionals. Our study clearly revealed that relevant learning theories and principles were used to inform vital curriculum development and implementation decisions at MLT the programme. For instance, learners appreciated that the MLT curriculum involved implementation problem-centred and learner-centred strategies. The learners also confirmed that the curriculum content was based on real life issues and its implementation allowed them to participate in class and practicum clinical related areas. All these practices and principles were consistent with various learning theories such as Humanistic Learning Theories. And concur with Bleakley et al. [3] who assert that curricular for training health workers should have reflectivity in community and this curriculum is in that direction.

Indeed, for the smooth running of the MLT programme, there was also need to align curricula with the local context in which it was to be implemented. Considering the Ugandan context as a developing country, in addition compounded by issues of globalisation learners were required to also learn how to perform the less sophisticated manual procedures. This was necessary because in developing countries the less sophisticated manual procedures were relatively more affordable and therefore commonly practiced at Primary Health Centres than more sophisticated modern procedures such as genetic engineering. Genetic engineering as a modern procedure was incorporated into the MLT curriculum as a vital professional practice and skills development aspect necessary for the 21st century [66]. This was ideal for preparing learners to function effectively in the real world of work as clinical professionals as well as consistent with the Phenomenological-hermeneutic Theories basic principles.

Furthermore, this study has also revealed that principles of other learning theories such as behavourism and constructive alignment were fundamentally influential in the MLT curriculum design and implementation process. For example, the results of the study showed that curriculum documents contained clear laboratory manual procedures and strategies for routine rotation of learners through various laboratories. In addition, the curriculum was intended to achieve horizontal organization and alignment to local rural health conditions to give learners opportunities to reflect on. This agrees with Bleakley et al. [3] that training needs are reflectivity in community.

6.1 Curriculum Alignment

The focus on ensuring curriculum alignment was critical in the MLT diploma curriculum. The curriculum was also in line with the existing international declarations and conventions. For instance, in accordance with the Alma-Ata declaration [87] health sciences education programmes are required to integrate primary health care approaches in their curricula. The aspects of utilising primary healthcare approaches were very important in the MLT diploma curriculum implementation. Through Primary Health Care (PHC) centres in the country, learners were oriented to numerous clinical related cases as well as conducting severance of diseases in communities. This way the MLT diploma curriculum was developed in alignment to the PHC international declaration requirements. These practices were not only in line with the 21st Century Learning Theories, but also prepared learners to become relevant as contemporary clinical professionals.

Indeed, other alignment issues that were also considered included **identification** of appropriate courses and teaching strategies for the MLT programme. The results of the study show that appropriate courses and teaching strategies to facilitate the learning processes were used. The teaching/learning processes involved the use of experiments, integrated teaching using real life examples, drawing on what learners practiced in practicum sites and communities. This approach helped learners develop critical thinking skills and creativity, generated and used evidence to justify facts, competences that are required for the 21st century [25]. What comes out clearly is that relevant modern and international approaches in the teaching and practice of the MLT profession were incorporated and emphasised in the implementation of the curriculum. This is in line with Carl [88], Amri, Ngatia and Mwakilasa [89] and Harden, Sowden and Dunn [90] who suggest the use of integrated teaching and development of learners' ability to conduct research as being a necessary component in curriculum implementation especially in medical (health sciences) education. As such, our study showed that efforts were made to align the curriculum to current educational trends in the MLT subject disciplines.

This was also consistent with recent research by Errington [44,45] and Biggs [46] on constructive alignment aims at establishing relationships between the curriculum and its various contexts.

The results presented in this section revealed that constructive alignment was carefully followed, planned and applied during the curriculum design and implementation of the MLT diploma programme. It is clear that constructive alignment theories were vital for the appropriate integration of both for local and global issues in the MLT curriculum and training. The curriculum alignment practices found in this study were also in agreement with the views of Bleakley et al. [3] that there was a need for a paradigm shift from relying on classroom teaching to reflection in community and from interprofessional to multiprofessional training approaches.

6.2 Integration of Basic Scientific Knowledge

We appreciate the need for a paradigm shift suggested by Bleakley and others about the quality of learners being recruited into clinical related programme. The results from the analysis of the curriculum documents showed that learners on the diploma programme who were recruited had a background of basic sciences such as biology, physics, chemistry, and mathematics. And the prior basic scientific knowledge was a prerequisite for learners to be introduced to the applied health science knowledge and this was clearly reflected in the MLT diploma curriculum organization structure. This organization of the curriculum defined the context in which learning had to take place and gaps that needed to bridge in order to turn a school leaver into an efficient medical laboratory Technologist. This is also in line with the Phonological-hermeneutic Theories of learning [7,39]. Hubball & Edwards [91] explain that a curriculum needs to be aligned to the different concepts that form its contexts.

The organization of the curriculum described in the above paragraph is based on the belief that meaning gets derived when the health science knowledge is linked to the already existing basic science knowledge. For instance, in medical laboratory sciences, the knowledge of pathology could be integrated with the knowledge of physiology that is studied in basic sciences. Relating the knowledge of applied science to that of basic sciences helps learners to derive new meaning. Teaching of the basic sciences therefore prepares the learners to receive knowledge of applied sciences which is consistent with cognitive theories of Ausubel [15,16]. Furthermore in the practicum sites

learners discover abnormal presentations of pathological conditions and relate them with the normal physiology. The comparison of the two again assists learners to derive new meaning. As they are able to compare the normal physiological conditions with the pathological ones and describe them in the laboratory reports to clinicians. This organization of the MLT diploma curriculum was done on the basis of phenomenological-hermeneutic theories where learning is taken to be in the context of wholes and not fragments, where new learning is integrated with previous learning, theoretical learning is also integrated to practical learning to derive new meaning thus having integrated various domains of knowledge. This is also consistent with Phenomenological-hermeneutic Theories as described by several scholars [7,38,92].

6.3 Learner-centred Approaches

Learner centred approaches were considered to be very vital for the MLT curriculum implementation agenda. The results of the study showed that curriculum implementation included learner-centred teaching methods. For example, learners were allowed to identify projects of their own choice and conduct private individual studies on these projects. This made learning to be focused on the interest of individual learners. This also created a feeling of self-fulfilment among individual learners. It further led to the development of significant intellect and creativity among them. The approach created a free learning environment characterized as devoid of restrictions. As such, the teaching process focused on moderation of the learning process by concentrating on bridging the gap between what the learner knows and what s/he should know. This is also consistent with Phenomenological-hermeneutic Theories as discussed by several scholars [6-8,39,43]. A learner centred curriculum takes into consideration the diverse interests of diverse learners and this can only be achieved if the curriculum development process permits the integration of a variety of learning theories. This agrees with [5] who explains that "Application of a variety of learning theories responds well to the diversity of learning needs for the diverse learners". It is further in line with [3] who contend that "No single learning theory has enough explanatory and predictive power to inform the range of practice found in medicine". This curriculum integrated learning theories in a

context is congruent with modern scholarly work in health sciences education.

6.4 Group and Individual Projects

In the process of carrying out their projects, learners investigated situations and made their own judgment. This gave them an opportunity to study issues in their natural environment and made their own deductions and individual learners were required to write reports for their projects. This is consistent with the deconstruction theories of learning [47] where learners are expected to investigate the validity of the established beliefs with a view of discovering new linkages, which enhances critical thinking skills of learners. This concurs with views of Bleakley [3] and the others that "the higher education goal of developing critical thinkers taught to deal with abstract knowledge is somewhat at odds with this interest in practical knowledge, identity, community, and responsibility through context-driven ethics". These new trends in health sciences education enhance the learning of traits that are tailored to the diverse challenges of learning and healthcare practices.

Indeed, collaborated responses from the learners and educators show that learners acquired skills from conducting experiments in class using laboratory protocols/ standard operating procedures (SOPs) under specified conditions. In this respect learners are expected to perform laboratory procedures following the written protocols and eventually to understand the rationale behind following the various procedures. They can thus develop important insights and eventually to master laboratory cultures and routines. This is in line with the Gestalt Field Theories where learning is believed to occur as a result of development of the thought processes, insights, perceptions, coding of information, recreation and reconstruction of the memory [6,7,14]. Understanding laboratory cultures and routines may occur after one interprets and perceives the rationale behind each of the procedures. This is in agreement with the views of Gravett [14] in that the extent that learning occurs when interpretation and perception of situations are acquired by the learner and that interpretation and perception are not overt thus not observable. It is clear that the curriculum development process of the MLT diploma curriculum appropriately integrated the Gestalt Field Theories.

6.5 Experimental Work

Our findings are also congruent with Pritchard's [12] views on behaviourism approach. According to Pritchard behaviorism approaches should be the basis for programmed learning and best suited for skills development. Integration of behaviourism learning theories in the MLT diploma curriculum is therefore suitable for guiding learners to acquire skills as opposed to an only knowledge based curriculum. Results revealed that learners were required to perform similar experiments over and over again. This helped them interact with the situation under which the experiments were conducted repeatedly. Subsequently, over time they acquired valuable knowledge of the various conditions and routines under which various experiments are performed. This concurs with the views of De Villiers [17], Spector [93] and Vygotsky [18] drawing on cognitive theories, in that learning takes place through interaction, dialogue, collaboration and development of conceptual frameworks. This process involves thinking, development of understanding, analysis and synthesis. This is also consistent with the views of Halpern [25] regarding cognitive processes. It is also consistent with the views of Woolfolk [26] and Marzano and Pickering [27] on metacognitive application. Regarding metacognitive application, these authors assert that knowledge is acquired as a result of learners ability to develop personal learning strategies based on the gained insights into their individual learning competences. This is also consistent with the views of [3] who contends that through the acquired metacognition, learners should gain new meaning from learning. As such, our study revealed that the MLT Diploma curriculum was compliant in that it was designed drawing on principles of metacognition learning theories and this has made a difference in enhancing effective learning outcomes and experiences.

6.6 Practicum Attachment Experiences

Studying the curriculum for practicum attachment of individuals revealed that learners were to practice as they observed how the MLT profession is practiced as a whole. It was also in line with the Phenomenological-hermeneutic Theories where learners look at laboratory practice as a whole and not restricted to individual experiment. This corresponds with explanations of some scholars with regard to application of Phenomenological-hermeneutic Theories [6-8,43].

As one interacts with the environment, new ideas emerge and deeper learning occurs. According to Wink [21] when new ideas combine with experience, new meaning is developed and communicated in a language. Indeed, out of the findings of experiments, learners understand the existing physiological status of patients and communicate them into technical patients' laboratory reports to clinicians. Furthermore, it is clear that learners were expected to practice in field practicum sites under supervision and mentorship of the senior health professionals. Therefore, learners were expected to learn as they observed and participated alongside with the senior professionals in practice. Responses from clinical supervisors (93%), educators (91%) and learners (74%) revealed that this strategy was implemented as recommended during curriculum design. Learners in field attachment discussed issues of theoretical content and professional practices with their clinical supervisors; as a result they acquired new knowledge, learnt new skills and developed new meaning. As such situated learning was reinforced. This is consistent with socio-cognition theories of Vygotsky in that learners should acquire learning as a result of interaction with senior professionals and experts [18,25,29,30]. When both learners and senior professionals engage in a process of teaching and learning through dialogue and intervention, significant learning takes place. In addition, Dialogic mediation learning approaches [19,31] comes into play in that the seniors or experts act as mediators in the learning of the young [13,20,21] as well as role models in the profession. In other words, learners are socialized into the healthcare profession.

6.7 Flexibility of the Programme

Flexibility of any curriculum is critical for its success. Results revealed that curriculum regulations allowed provisions for candidates with lower qualifications to enter into the MLT programme who were able to obtain higher qualifications on completion of the programme. The curriculum regulations also allowed learners to leave the training at some point and rejoin at a later time. This approach was within the context of humanistic theories of learning. Humanistic learning theorists suggest that learners should be helped to achieve their natural desire and exercise their capacities to learn in order to gain self-actualisation [40-42]. By allowing learners of lower qualification to enter into the programme is out of the realisation of the inherent potentiality to

learn that exists in every individual. Every learner can learn. This practice allows them to exploit their capacities to learn based on the belief that man is a unique creature with various capacities, self drive and having a natural desire to learn. Accepting learners to take a break in their studies and resume again when they are socially and mentally ready is also in context with the humanistic learning theories. This helps learners acquire the qualifications they may desire to acquire and they thus feel to have socially, academically and mentally accomplished their desires. This way learners are given an opportunity to be in control over their own learning and education. This brings about well-being in many aspects of their life, in particular, which leads to self-actualization. As such, through flexibility many learners were given chance to access MLT programmes that otherwise would have been impossible.

7. CONCLUSION

Learning theories are central during the process of curriculum development and implementation. This study evaluated whether and how various relevant and appropriate learning theories were applied in the curriculum design process of the Medical Laboratory Technology (MLT) diploma programme in Uganda. Curriculum designers should consider relevant and appropriate learning theories to inform the curriculum design and implementation decisions. This is even more important today than ever before given the dynamic rapidly changing medical conditions that render many healthcare providers somewhat irrelevant. These trends challenge the quality of training and curriculum relevance in meeting the ever changing professional demands of contemporary medical workers. This desire is unachievable without the reality to apply frameworks of relevant learning theories.

Learning theories not only guide curriculum designers in making appropriate choices especially in the selection of teaching methods, but also strategies for assessment of learning outcomes [2]. From the discussions above it is clear that during the curriculum design processes at the MLT, relevant learning theories were considered. Therefore appropriate strategies were used during curriculum implementation. As such, competent cadres of Medical Laboratory Professionals were prepared to function within the context of contemporary Medical Laboratory Practice.

Thus, various learning theories were applied, the discussions showed that curriculum implementation aimed at addressing content issues, growth of individual learners as well as focusing on development and growth within the Medical Laboratory Profession.

The curriculum was also aligned to appropriate principles of curriculum development; namely being relevant to the social and professional context as well as having linkages between its elements i.e. between the subject content, teaching methods, assessment and evaluation. The study results showed that the content of the curriculum was also based on real healthcare needs identified in the Health Sector Strategic Plan (HSSP) and sound principles for health sciences curricula [94,88].

Our study has revealed that application of relevant learning theories at the MLT programme led to a better understanding of the diverse learning needs of increasingly diverse learners. The learning theories informed/guided important curriculum decisions into choices for learner centred teaching and learning experiences that were appreciated by all stakeholders (learners, clinical supervisions, and tutors). Indeed, appropriate instructional methods and proper assessment procedures [2] were adequately used. As already indicated [5] that "Different learners learn best in different contexts and by different approaches, we can help our learners discover what works best for them by presenting them with different possibilities and encouraging them to reflect on their learning experiences, and that some do best alone and others in small groups".

What also came out clearly from this study is that creating opportunities for learners to practice what they are learning especially through field attachments helped them to reflect on their theoretical knowledge and the practical realities in the clinical sites. These enabled learners try to understand and master the theoretical content and to gain professional socialisation as a result of their interaction with clinical supervisors and other experts. For instance, I (author) personally gained a lot of confidence in medical education as a result of interacting with retired Professor Tom Hayes at the University of Wales at Cardiff in the United Kingdom.

Therefore, our study contributed knowledge on curriculum in clinical related training programme and associated application of learning theories. It

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is evident that the integration of relevant learning theories in the curriculum design process added great value to the quality of training of healthcare professionals. As such, what comes out clearly from this study is the fact that application of relevant learning in the curriculum design and implementations processes in the contemporary clinical training programmes is critical.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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