Figure7: Throughput vs. learning rate

Learning rates of Q-routing and DRQR for particular packet creation duration (0.175) has been varied and shown in fig. 6 and fig. 7. It is shown that the average delivery time of packets for Q-Routing remains low at 0.7 (fig. 6), while the throughput remains high at 0.7 for DRQR (fig. 6). However, these figures are only valid for our test environment and effect of learning rate needs to be investigated in the future for different systems for a more general figure rather than using constant values based on experience.

VII. CONCLUSION

Q-Routing does not always guarantees finding the shortest path. Moreover they can only find a single path, but cannot explore multiple paths. In the Q-Routing, routing is proportional to the data traffic. Therefore network emerges lower in low data traffic, hence routing algorithm works slower. This is not a desired property as a routing algorithm should perform the same under all traffic conditions. At the same time the shortest path algorithms also ignores the bottleneck as the network traffic increases. However, the need for a reasonable and efficient algorithm, which is consistent and adaptive, is as strong as ever.

REFERENCES

[1] Tanenbaum, A., "Computer Networks", Prentice Hall, Fourth edition, Chp. 5., 2003.

[2] Dijkstra, E.W., "A Note on Two Problems in Connexion with Graphs", Numerische Amthematik 1: 267-271, 1959.

[3] Boyan, J. A., Littman, M.L., "Packet Routing in Dynamically Changing network: A Reinforcement Learning Approach", Advances in Neural Information Processing Systems 6. MIT Press, Cambridge, MA, 1994.

[4] Kumar, S., Miikkulainen, R., "Dual Reinforcement Q-Routing: An Online Adaptive Routing Algorithm", Artificial Neural Networks in Engineering, 1997.

[5] John T.Moy, "OSPF Version 2", IETF 2328.6.Bellman, R. E, "On a Routing Problem", Quarterly of Applied Mathematics 16 (1978), 315-333, 1998.

[6] D. P. Bertsekas and R. Gallager,Data networks, Prentice Hall, ISBN: 0132016745, Chp. 5., 1991

[7] R. S. Sutton and A. G. Barto, "Reinforcement learning: an introduction", MIT Press, Chp.1-3, 1994.